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May 19, 1927

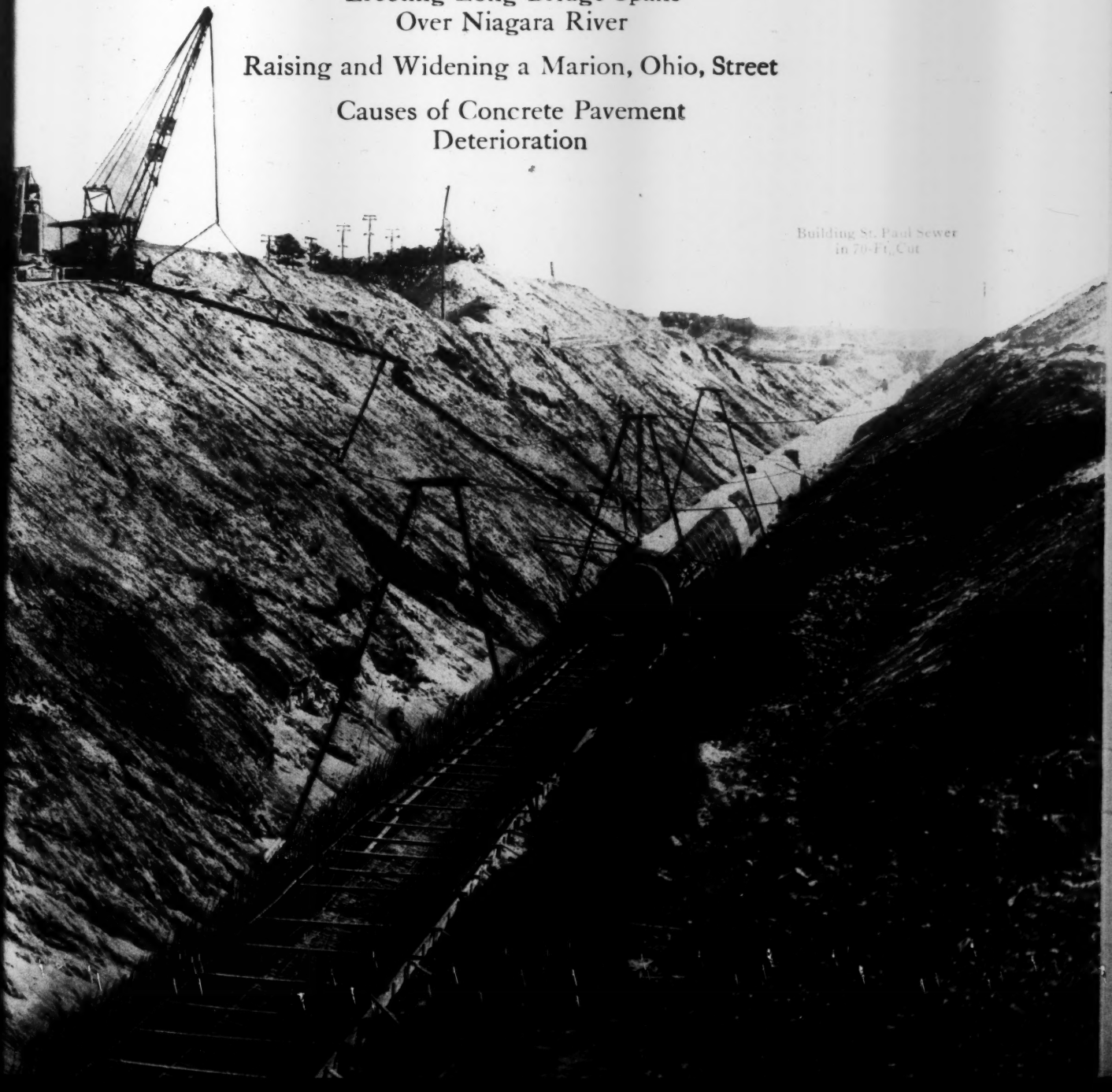
Engineering News-Record

Isolated Sewer System for St. Paul

Erecting Long Bridge Spans Over Niagara River

Raising and Widening a Marion, Ohio, Street

Causes of Concrete Pavement Deterioration



Building St. Paul Sewer in 70-Ft. Cut

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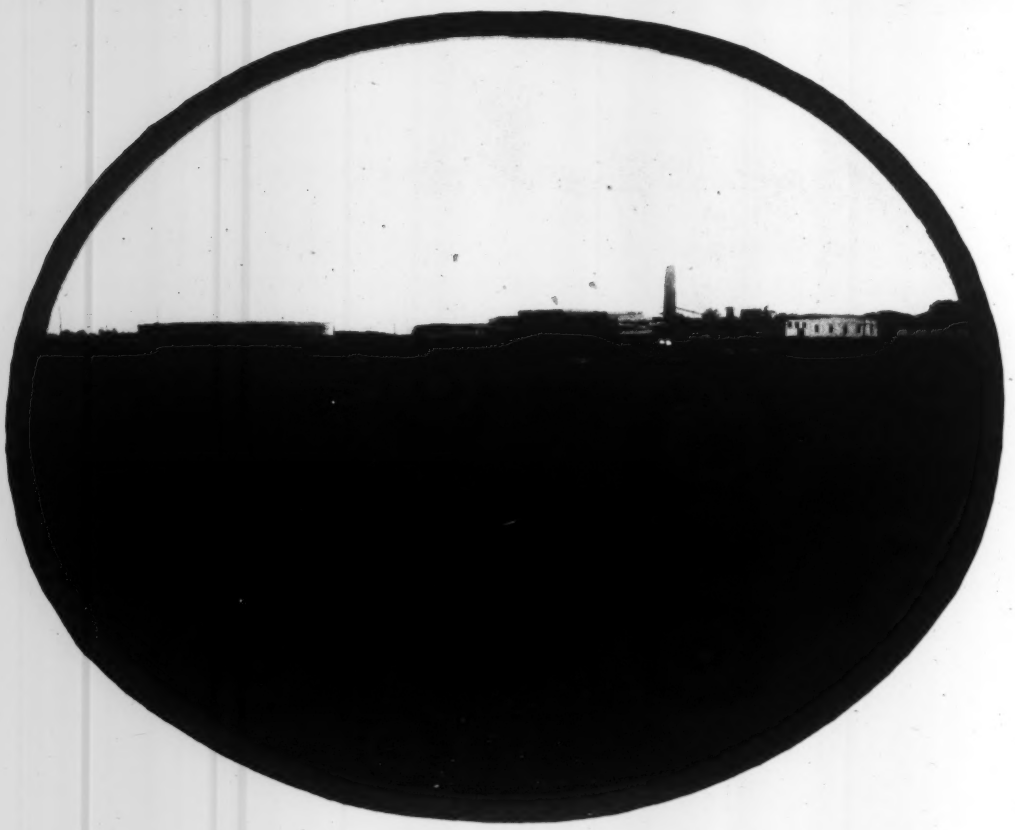

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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FRANK C. WIGHT
Editor

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An Engineering Obligation

NO WORD has come from Washington to indicate that the President is disposed to appoint an engineering commission to consider the problem of the Mississippi floods. This does not necessarily mean that Mr. Coolidge is not considering such a move, for he is by temperament and practice disposed to ponder long on the advisability of definite action. There is still time, therefore, to bring before him the views of the engineering profession. No agents are better fitted to do this than the engineering societies. Here is an opportunity for every society, and every chapter of a society, to serve the country. Each one so placed as to permit such action should call at once a meeting to discuss the advisability of petitioning the President to appoint such a commission or board as was advocated in these columns last week, and, provided there is agreement so to do, to urge upon the President the necessity of a full consideration by qualified engineers of this national problem. The report of the Mississippi River Commission will be made in due time, but that report will certainly be subject to question and attack by Congress when it meets. If at the same time the best advice of an independent engineering commission is brought to bear upon the problem Congress will have more than the report of those whose duty it is to study the Mississippi and will be that much further ahead in its consideration of its proper course. Let the President know what the engineers of the country think should be done.

New Knowledge and Industry

KNOWLEDGE promotion by industry either individually or through trade associations is one of the most significant processes that has been going on in our industrial field during the last decade or two. Experimental promotion and research work of great magnitude has proceeded under these auspices. Such work expresses a realization that the financial success of industry depends on conducting its processes in the most efficient way and developing the highest type of products. One may confidently expect that this realization will continue and spread, and will lead even non-competitive industries to enter vigorously into promotional study. Meantime, the forward-looking spirit of industry occasionally manifests itself in different forms. A recent instance is the offer of a large cash prize by a manufacturer of welding equipment for the year's leading contribution to the promotion of electric welding. The offer is testimony of the vigor and progressive spirit that animate this youthful and rapidly growing field of the metal-working art. No doubt it is founded on the hope of financial return just as is commercial research; nevertheless it reveals a spirit whose effect is to advance the powers of mankind generally just as the development of research knowledge operates to universal gain. In this particular competition the target set up for the competitors to shoot at is vaguer than might be wished, and the direct results, therefore, may not be as valuable and promotional as could be expected. Yet the very fact that industry comes forward with so open a hand to offer a reward for the promotion of a particular field through better practical knowledge is notable—more significant indeed than grants of some hundreds of thousands by a philanthropic but energy-less Foundation. It is a direct call from the firing line for help in pushing on the advance.

Road Behavior Censuses

PERFORMANCE surveys of road types are gaining importance. In the last two or three years they have progressed from counts prompted by personal interest or some business purpose to rather comprehensive censuses sponsored by technical bodies of reputation. Notable examples are the survey on the economics of reinforcement, on earth road types, and on culvert performance by the Advisory Board of Highway Research and the survey of concrete road deterioration by the Association of Highway Officials of the North Atlantic States which is summarized in this issue. Based on the hypothesis that if the compass of the survey is broad enough, legitimate conclusions can be drawn in ignorance of minor differences of structure, construction and service, these censuses are affording us a number of suppositions concerning highway design and construction technique. The point to be noted here is that the results warrant nothing more than supposition. The census summarized in this issue is no exception; the conclusions given are suppositions based on the personal interpretation of truth in a mass of contradictory evidence. This does not mean that the results are not useful, it is merely a warning to take them only for what they are. Doing this, the survey of New York, New Jersey and New England concrete roads reported in another column and the preceding report on reinforcement economics by the Highway Research Board are helpful sources of information. Specifically, the North Atlantic states survey deserves to be noted for the conclusions it arrives at concerning reinforcement and pavement thickness. It indicates emphatically that thicker pavements are demanded by present-day traffic and vehicle loads.

Scaling Pavements

LIKE freckles on a girl's nose, scaling on a concrete pavement arouses concern far beyond any implication of lesion which it affords. A scaled pavement looks bad and may make riding a little rougher, but there is no structural unsoundness premised. Reference is had to true scaling and not to progressive disintegration downward from the surface. True scaling is merely a facial blemish. It arouses criticism, however, and every concrete-road builder is seeking a corrective. Along this line the conclusions of the pavement survey just previ-

ously referred to offers some suggestions. Out of them two are prominent. Dirt in the aggregate and excessive finishing are the main things to avoid. It may be, and indeed the conclusions assert, that on occasions other causes are contributory, but dirt and overfinishing are the two which stand out. This is interesting because it agrees virtually with the conclusions of the state which has built more miles of concrete road than any other. Illinois now seeks to avoid scaling chiefly by using clean aggregate, by doing as little tamping as possible, and by care in finishing, particularly in employing processes to remove laitance. In this, its engineers hold, is the reason for scaling. If allowed to remain and harden on the surface, it forms a weak skin coat which weather, traffic, and particularly the cold, will crack and scale off the sound body of the slab.

Nicaragua and Panama

AN EDITOR cannot afford to make a mistake, for those that he does make are open to public gaze and to public condemnation. Inadvertently some weeks ago there was written in these columns, in commenting on Nicaragua and Panama, the following sentence: "No longer need the balance be drawn between the long sea level route nearer the states and the short lock canal which would mean some hundreds of miles more travel from coast to coast." Quite evidently, one might assume from that that Nicaragua offered a sea-level route. Obviously, it does not. Just as obviously the editorial pen slipped when those words "sea level" got into the text. The engineering balance between the two routes, however, did not lie in the distinction between sea level and locks.

A Drop in the Bucket

LAST week in our Random Lines column we recorded a few of the suggestions now rampant for solving the Mississippi River problem. Among them was the statement of a Canadian member of Parliament that the diversion from the Great Lakes to the Chicago drainage canal was doubtless responsible for a large part of the flood. This was taken to be a joke, but since then the anti-Chicago element along the Great Lakes and the St. Lawrence River has taken it up in a serious way. We find, for instance, in the Rochester *Democrat and Chronicle* the following sentences: "No small part of the trouble [of the Mississippi flood] is due to the diversion from the Great Lakes drainage system into the Mississippi drainage system of a greater volume of water than flows over the American Niagara Falls. Many thousand cubic feet a second are taken from Lake Michigan by the Chicago drainage canal, and it is stating it mildly to say that this water is needed in four Great Lakes and the greatest natural waterway on the continent where it belongs, whereas it only clogs and imperils the other system." Enough of this kind of nonsense will be spread before the people of this country to make Congress next fall a madhouse when it comes to considering the Mississippi River problem. It is true, as the newspaper editorial says, that about the same amount of water is passing down the Chicago drainage canal to the Mississippi basin as passes over the American Falls of Niagara, but it is further true, which they omit, that this amount of water is about one-twenty-fifth of the amount of water that goes down the Niagara River and that the amount of water that goes down the Niagara is about one-tenth the amount of water that is now going down the Mississippi so that the diversion which so concerns the Rochester editor is 1/250th of the flow of water which is burdening the levees and flooding the low lands of the Mississippi Valley. It would be hardly worth while to call attention to such elementary facts were not the capacity for erroneous conception of major physical problems apparently so limitless.

Structural Patent Obligations

ENGINEERS have never been friendly toward patents covering details of structural design. This is a result of the nature of engineering design for, by its very essence, design is the application of known principles and details to the use required and must always in some particular produce something different from that which has gone before. To the legal mind there is difficulty in determining in a specific case whether a result achieved is merely design or whether it has that novelty of material or arrangement which constitutes invention and, by the law, warrants the monopoly rights of a patent. But on the other hand the structural designer as a rule recognizes the essential novelty of all designs and does not attempt to assure for himself monopoly control merely because he has produced something not precisely like that which has preceded his design. But there are exceptions—and those exceptions for years have been a thorn in the flesh of the designing engineer.

Certain designs possessing no more novelty than hundreds of normal engineering designs have been dressed up with all the trappings of invention, have been accepted as such by the Patent Office, never very expert in the details of engineering structures where each design is a thing to itself as distinct from the manufactured article where repetitive production is essential, and have even been endorsed by the courts of law empowered to put the final seal on the claim of originality. This process has aroused constant resentment, not only because of the feeling that the legal processes by which these designs have been validated have been inexpert, in so far as knowledge of the essence of structural design is concerned, but because of the unfairness of having an insignificant minority of the many novel designs put into the monopoly class because the so-called inventor, or more often some promoter who has purchased the patent, chooses to avail himself of the inadequacy of this phase of our patent administration.

Resentment at the inventor who does take advantage of this laxness in the Patent Office and sometimes in the courts avails no one at all, because after all in this competitive world the law too often makes morality, but the insufficiency of the patent system to meet the problem of design is something that can be reformed. In too many cases when an engineer is confronted by a suit or a demand for royalty for infringement of a structural patent, he is easily influenced by legal advice. The ordinary patent lawyer, trained in the codes and procedure of the Patent Office, partakes of that office's lack of understanding of design. He, too, has fallen under the spell of the mechanical device and is ready to assume that if the structure has some element of novelty, it is of necessity an invention. He does not understand,

as does the engineer who has developed his art over the drawing board, that there is something new in every structure, but that underlying them all there are elements and that to put those elements together to serve a useful purpose is the essence of the engineer's skill and not the essence of invention. And so, too often, the lawyer advises submission to the patent demands or else, if the structure has not been built, a redesign to avoid difficulty. More and more frequently, however, there are coming into the courts engineers who have the courage of their convictions and lawyers who have overcome their inherited ignorance of structural design and who, by logical processes, have been able to convince the court that design is an orderly progress from the old to the new and always a rearrangement of accepted details and that few, very few, designs incorporate in their composition an essentially new conception—which is the requirement for invention.

Several such cases have been so decided in the past year or two. The courts are becoming more and more appreciative of this distinction in structural design and it behooves every engineer who is confronted with a demand for royalty to take cognizance of the fact, to require of his legal adviser a full examination of the possibilities of such a defense, and to make the most complete study of the history of the particular type of structure in question. Only by such action will he be doing justice to his own design—or to his professional obligations.

City Planning Progress and Problems

PROGRESS in some lines is not easily measured. This is particularly true of new movements which in their earlier stages are largely educational and have to break down the habits and traditions of government bodies, and at the same time educate a sufficient portion of the masses of people first to tolerate then to demand innovations.

Some twenty years ago, stated John Nolen last week in his presidential address before the National City Planning Conference, practically nothing had been done in the United States in the way of city planning. He might have said that the two words, as thus joined, were unknown to more than a very few in this country. In the past two decades city planning, while still unmeaning to the masses and anathema to some who have grasped its significance, has found its place in the theory and to some extent in the practice of municipal administration. And yet it is impossible to measure its progress in exact terms. This no one realized more fully than Mr. Nolen when he said that starting with zero twenty years ago, over 150 cities have since been replanned, nearly 400 have created planning commissions and some 460 have adopted zoning ordinances. In most cases, as Mr. Nolen understands, it is a far cry from creating a planning commission or from the submission of a city replan to anything more concrete. Fortunately there are exceptions—some extensive, others chiefly minor—but for the most part city planning achievements in the United States have not yet gone far beyond the educational field. The work done here is notable. Moreover, the foundations have been laid for an immense amount of physical accomplishment, much of which will materialize in the near future.

Many problems remain unsolved, wholly or partly. Among those mentioned by Mr. Nolen is the congestion of population and of traffic. The problems in this category are tangled on the one hand with various interests of land and building owners and brokers, and on the other with unplanned or poorly planned street and transportation systems. To the correction of the latter many of the plans alreay made or now being made are directed. As a matter of engineering, from the physical side alone, planning here, although sometimes difficult, is not at all baffling. The difficulties lie (1) in overcoming objections to their execution strenuously raised by property owners and others personally or commercially interested, and (2) in finding the money to do the work.

This for replanning of occupied areas. In undeveloped areas the obstacles are fewer and less difficult—at least physically and financially. Here skillful zoning—and more cities have zoned than have had city plans made or created planning commissions—is rapidly smoothing the way. Here, too, much help has been given—as well as much opposition been made—by real estate owners and operators. It may be expected that this help will increase and the opposition decrease now that co-operation between committees of the City Planning Conference and the National Association of Real Estate Boards has resulted in recommendations governing subdivision of land, as noted elsewhere in this issue.

One of the greatest problems incident to getting city plans beyond the mere paper where so many of them are gathering dust is how to make city planning a vital organic part of city government. Many if not most of the cities mentioned by Mr. Nolen as having been replanned find their place is that classification not through any act of the city government. This was more true in the earlier years of American city planning than now, for most of the early plans were ordered and paid for by private or civic organizations, only to be submitted to the city officials and by them filed and forgotten. Even with our present official planning commissions the best of plans are too likely to meet the same fate. This is partly due to the financial and other difficulties, already mentioned, in getting plans put into execution, but it is also due in large part to the fact that neither city officials nor the public yet realize what city planning is—its nature and value. Hence the gap between the city planning and other departments of the city. When planning is recognized and dignified as a city department a change for the better may be expected.

The term "city department" is used to indicate an integral part of the city administration rather than the exact form which that part shall take. The function of the department, whether it be a planning commission or a bureau, is to frame a city plan, and recommend changes in it, and pass upon changes proposed by other branches of the government. Recognition of the importance of an "official plan" or "master plan" by city legislators, administrative officials and the public whom they serve is essential to city planning progress. Such a plan is a far different thing from the "plans" made for some scores of cities mentioned by Mr. Nolen, scarcely one of which has ever been legally adopted. The notable exception of adoption of an official plan with means provided to see that the plan is followed—or departed from only after careful deliberation—is afforded by Cincinnati, one of the most notable achievements of the past two decades.

Erecting Long Bridge Spans Over Niagara River

Superstructure Work of Buffalo-Fort Erie Bridge Handled With Help of Ingenious System of Removable Steel Spud Cribs as Falsework Supports—Entire Erection Carried Out in One Season

ERECTION of the international bridge between Buffalo, N. Y., and Fort Erie, Ont., now nearing completion, presented a number of quite unusual difficulties. On the one hand, rock bottom and a rapid swirling current made the question of supporting the falsework for superstructure erection quite formidable. On the other hand, the contract for the superstructure set a working schedule which in view of the river conditions could be met only by the most energetic and systematically planned work. It was specified that liquidated damages should be deducted from the contract price for failure to complete on time, while a bonus would be paid for completion before contract date, so that it was of great importance to the contractor to complete the erection as rapidly as possible. These and several related difficulties led to the development of a new and very successful type of falsework support—a steel skeleton crib carried by pointed steel spuds resting on the bottom—and resulted in a remarkably rapid piece of steel erection. A brief account of the work is given in the present article.

This bridge, to be named the Peace bridge in commemoration of the more than 100 years of continuous peace between the two countries which the bridge will join, will be the first highway crossing of the Niagara River south of Niagara Falls. Ferry service between Buffalo and Fort Erie has existed for many years, but it has been inadequate and slow, and subject to interruption in very stormy weather. In 1912 a bridge across the Niagara River at Buffalo was planned, as a memorial peace bridge, to be one of a series of monuments along the frontier, but the federal governments of the two countries did not act on the plan, and later the World War compelled the project to be postponed. It was taken up in 1919 by citizens of Buffalo, who, with the support of individuals and communities on the Ontario side, organized a company which is building the bridge as a private undertaking for public use. The corporate obligations are to be paid off by toll revenue, and thereafter the bridge is to become the property of the State of New York and the Dominion of Canada, or agencies designated by them. Under these circumstances, there was no difficulty in financing the enterprise and the required bond issue was oversubscribed three times.

Conditions of the Work—For better understanding of the conditions controlling the erection an outline drawing of the structure is given in Fig. 3. The main part of the bridge consists of a 360-ft. through riveted span over the Black Rock ship canal and five plate-girder arch spans ranging in length from 423½ ft. to 346½ ft. center to center of end pins. The rather unusual profile is dictated by the topography of the shores and the War Department's requirement of 100-ft. clearance height over the full width of the canal. The structure carries a single deck with 36-ft. roadway and two 6-ft. sidewalks, the roadway having a 7-in. reinforced-concrete floor slab crowned 2½ in. and paved with 4 in. of granite block. The slab is supported by 21-in. 60.4-lb. I-beam stringers spaced 4 ft. 9 in. to 5 ft. 8 in. apart, except that under the (future) street-car rails the stringers are doubled 15-in. I-beams. For the present the rail spaces will be floored with a continuation of the regular pavement, but bent plate clips are provided on top of the stringers to permit ready attachment of rails at a later date, after removing the pavement.

The water at the site of the bridge is 16 to 20 ft. deep, with bare rock bottom and very swift current. Except for a few sand barges and small tugs, all water traffic goes through the canal.

About 9,000 tons of steel are contained in the superstructure. Contract for its fabrication and erection was let on Nov. 6, 1925, and it was stipulated that the steel-

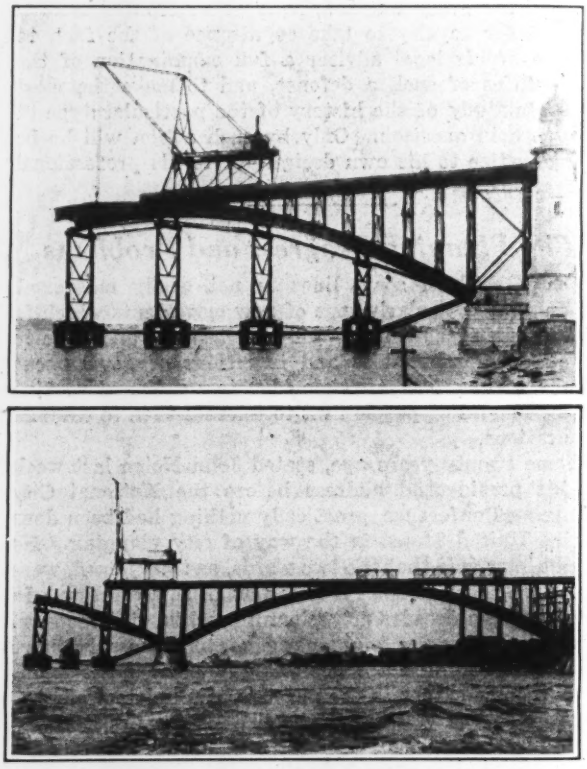


FIG. 1—ARCH ERECTION, FIRST AND SECOND ARCH SPAN

work should be completely erected by March 1, 1927, subject to liquidated damages or bonus ranging from $100 to $250 per calendar day for various parts of the work. A further condition was imposed by the War Department, which in view of navigation through the canal, usually extending over the season April 1 to Dec. 15, required that falsework must be removed from the canal before opening of traffic or else tug service would have to be provided to take all boats through, and further required a minimum opening in the falsework 94 ft. 4 in. wide by 89 ft. 3 in. high. This condition was particularly difficult to meet as high winds, snow and cold weather prevailing between December and

March limited the effective working season practically to the time from March 15 to Dec. 20, leaving only about nine months in which to erect, rivet and paint nearly 9,000 tons of steel.

Accordingly, the major conditions which the contractor faced were: (1) Erection over the canal must be started in March; (2) falsework must be removed from the canal before navigation opened; (3) falsework had to be devised that would withstand the unusual current and be suitable for the rock bottom, and at the same time could be erected and removed expeditiously; (4) the various parts of the work must be completed at a record pace to avoid damages and if possible earn a bonus. It was also necessary to plan for some flexibility, so that if the work was delayed at one point, even though the contractor was not responsible for this delay, it could be carried on at another point and the lost time be kept to a minimum. Extension of time due to delays caused by others was of comparatively little value, because if erection was not completed by the winter of 1926, the contractor would either have to work through the winter or carry the job over and reorganize the next spring at considerable expense.

General Erection Plan—The following plan of procedure was adopted: Erection was started at the plate girder span east of the canal, whose foundations were among the first to be completed. Material could be delivered to this point by rail. Equipment could be placed on this span and erection of the canal span could immediately be started, following then with the arch spans over the river, from east to west. At the same time a second gang and equipment would erect span 6-7 on the other side of the river, this second gang either continuing erection eastward over the river or transferring with equipment to the Buffalo side to erect the Buffalo approach, or do both, as conditions permitted. A third gang and equipment would erect the plate girder work on the Canadian approach.

As material shipped into Canada for use west of pier 7 would be subject to duty and to a sales tax, this part of the work was sublet to the Hamilton Bridge Works Co. of Canada.

Making the detail drawings, particularly for the structure just east of the canal, which is on horizontal and vertical curves, was carried out as a rush job by draftsmen sent to the office of the consulting engineer so that material could be ordered and fabrication begun at the earliest possible moment. Meanwhile the erection plan, equipment and other features of the field work were being developed.

Special Falsework—Special studies were made of the falsework to be used, as it was evident that ordinary wooden falsework would not hold on the smooth rocky bottom against the swift current. While cribs loaded with stone could be used, they would be expensive and difficult to set, and would form a serious obstruction in the river. A large force would have to be used to place and remove them if work was not to be delayed.

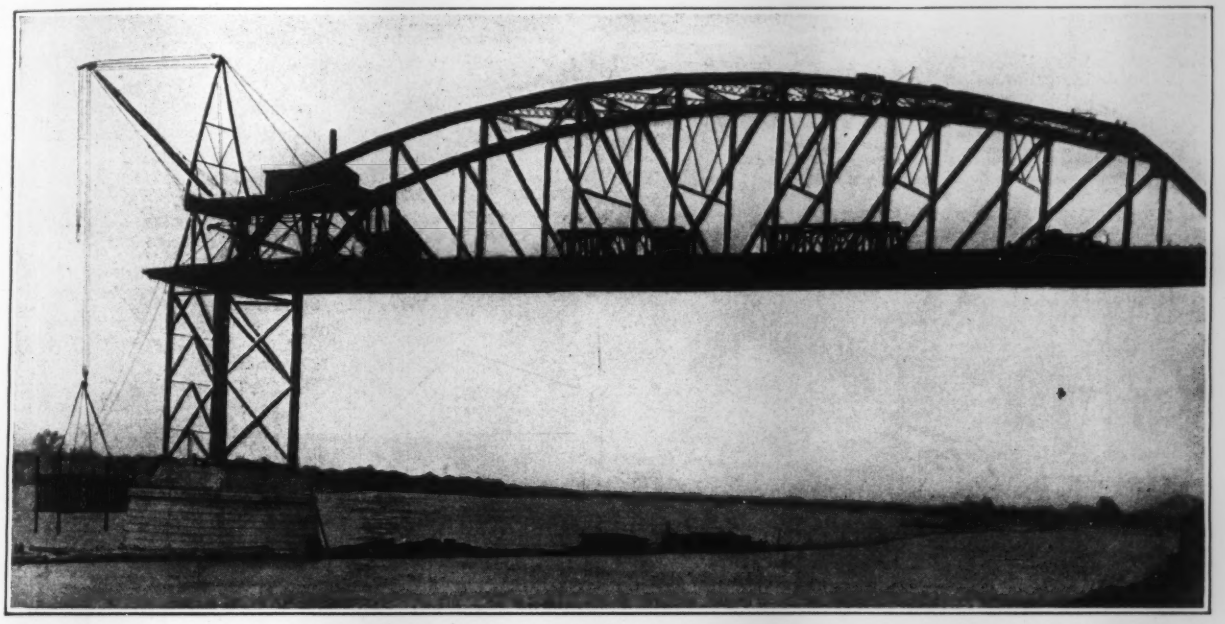


FIG. 2—SETTING FIRST CRIB IN RIVER FROM WEST END OF CANAL SPAN

An unusual type was developed, which was planned to offer little resistance to the current and to hold fast on the rock bottom. It is shown by drawings in Fig. 3 and by views in several stages of erection and use in Figs. 2 and 4. These illustrations represent the typical falsework used for the canal span and for all the spans over the river; under spans 5-6 and 6-7 it was slightly modified, as the water was shallower and the current not so strong.

The steel crib is 12 ft. by 47 ft. 8 in. in horizontal dimensions and is made up of two vertical trusses forming the long sides, each 14 ft deep, held 12 ft. apart by cross-frames at 10 to 12-ft. intervals and by a lateral system. Fastened to the trusses are vertical I-beam guides, between which steel piles or spuds made of 14x10-in. H-sections pointed at the lower end and reinforced at the point could be driven down. There were 20 such piles per crib. The crib itself was attached

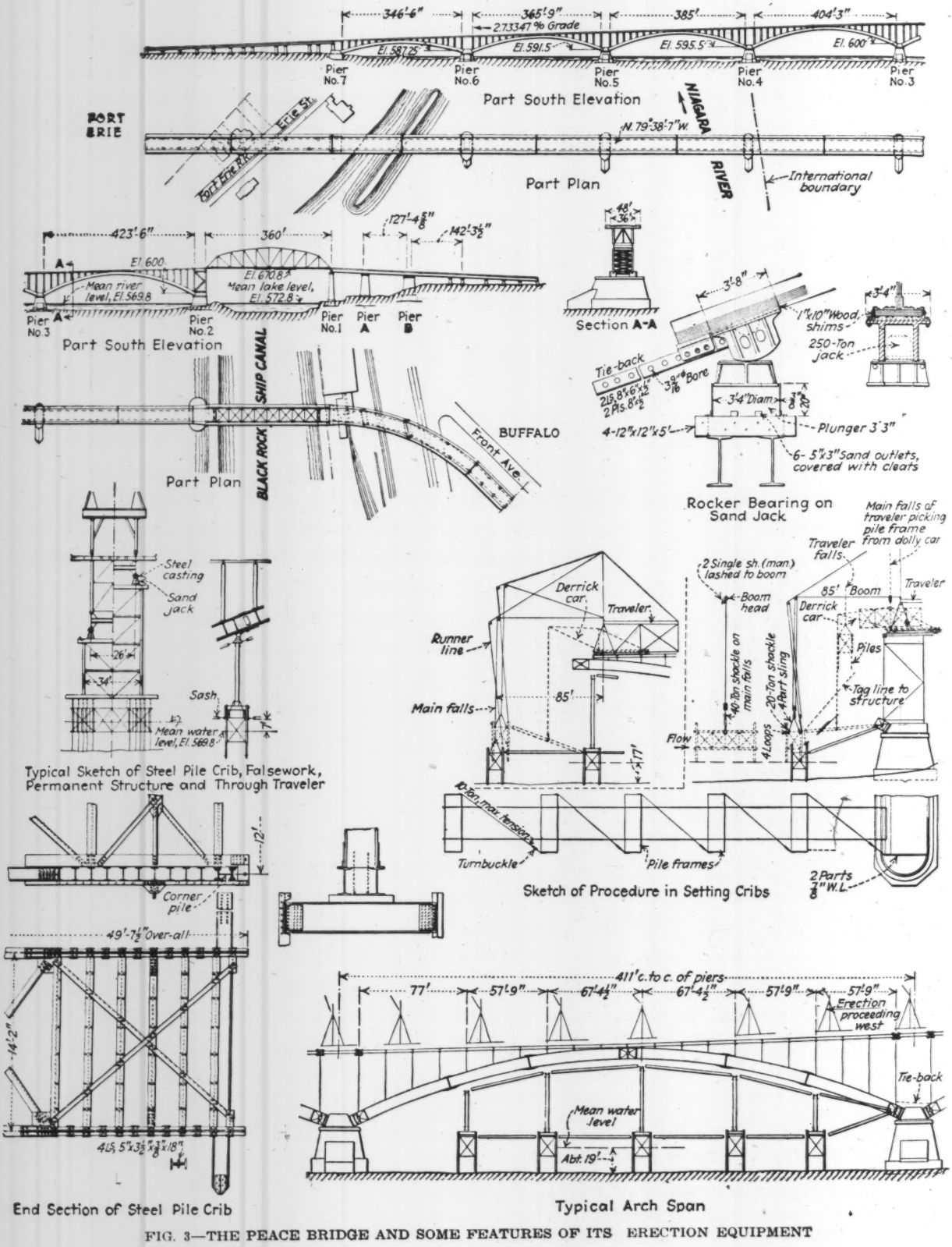


FIG. 3—THE PEACE BRIDGE AND SOME FEATURES OF ITS ERECTION EQUIPMENT

to the four outside corner piles by a bolted connection which by the provision of a series of holes over a vertical range of 7 ft. permitted raising or lowering the crib and fixing it at the required elevation. The crib was placed in the river just high enough for high water to pass under the struts connecting adjoining cribs, while the lower part of the crib was several feet under water.

Above the crib the tops of each pair of piles were connected by transverse I-beams by adjustable connections, permitting placing the beams level and at the proper elevation. Blocking on top of these beams carried the sill of the steel falsework bent which supported the bridge superstructure during erection. On the downstream side the sill was also clamped to the crib.

the remaining falsework bents and superstructure steel, completing its work by June 1.

On the American side field work started on Feb. 8. A 60-ton locomotive crane erected span A-1 and also placed a 50-ton material derrick on the east end of the span. With this derrick a traveler was erected on the west end of the span, and a derrick car was lifted up to feed the traveler and erect cross frames, top laterals and the like for the canal span. The traveler itself erected all the main material for the 360-ft. through span over the canal.

In the construction of the canal span, the steel crib falsework as described had its first use, three cribs being used. Experience soon showed that it could be set quickly and held well on the rock bottom. The last

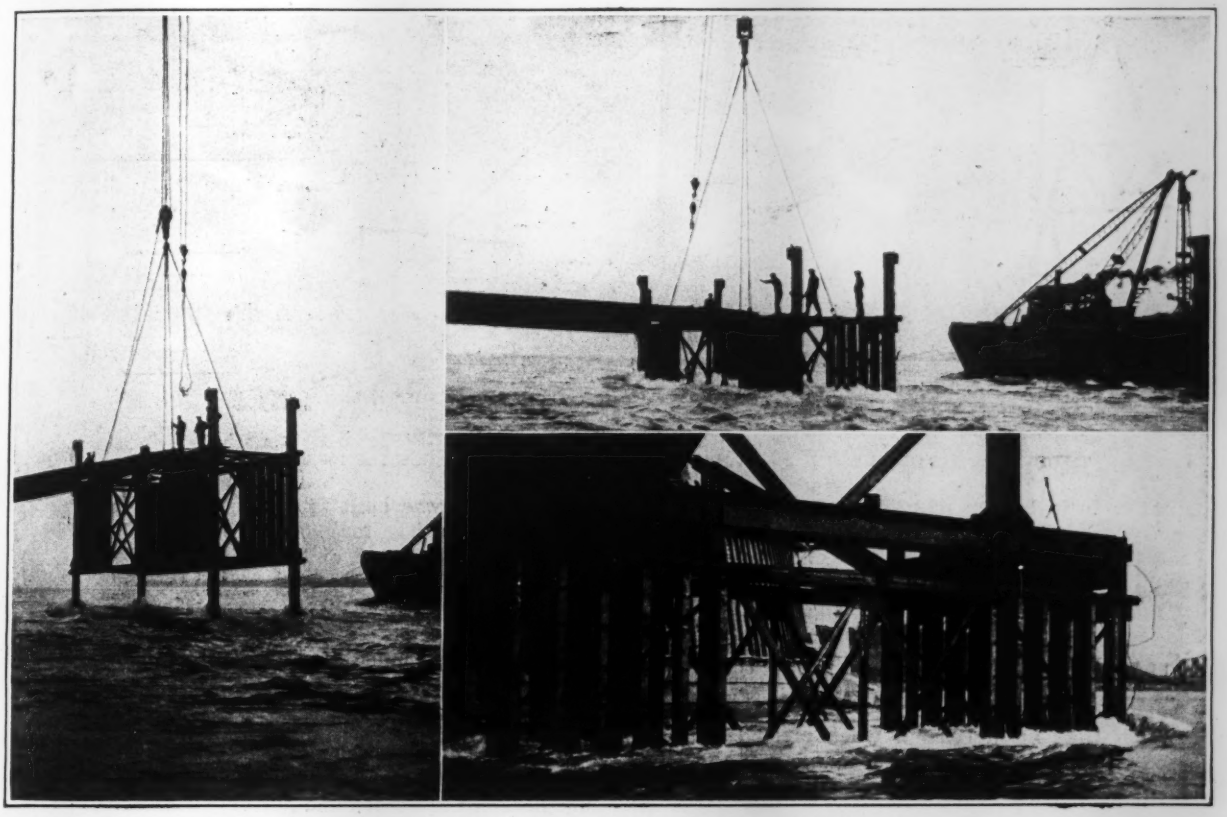


FIG. 4—A FALSEWORK CRIB IN THREE STAGES
Lowering crib into water—Landing the crib—Crib in service carrying steel falsework bent.

The falsework bent had splices in its legs to permit building up to various heights to suit the different elevations of the arches. The connection of the top struts of the bent was also made adjustable for the purpose of leveling up. On this top strut were carried two sand-jacks on which rested castings whose lower face was cylindrical so that they could take proper bearing notwithstanding the different slopes of the arch sections.

Patent on this crib construction has been applied for.

Erection Procedure—Work on the Canadian side started on March 23, 1926. The first falsework bent and the first section of steel for arch 6-7 were erected by a 30-ton locomotive crane, which then placed a traveler on top of this steel. This deck traveler placed

of the falsework was removed from the canal by June 2, about a month after navigation opened.

When the canal span and the tower at its outer end had been erected, the traveler began the erection of the first arch span in the river, span 2-3. It first set the upper and lower shoes of the arch on pier 2, and then set the first falsework crib in the river. This crib was connected to the permanent arch shoes by an upstream and a downstream strut, turning on a horizontal pin at each end, which located the crib at the right distance from the masonry and in the line of the bridge. It was also held by a horizontal guy from its lower corner to the upper edge of the pier, to take the pressure of the current. After the crib was in position the other sixteen piles were dropped into place and tapped with

a hammer to see that they took proper bearing; then the cross beams were connected to the tops of the piles, the sills placed on them and the falsework bent erected. The position of the top of this bent was fixed by two pin-connec ed struts from the permanent arch shoe.

This operation completed, the first section of the arch rib and floor was set in place. The traveler then moved forward and placed another falsework crib, bent, etc., and so in sequence to the end of the span. Each crib was connected to the one previously in place by an upstream and a downstream strut pin-connected at each end, and its downstream end was guyed to the upstream end of the previous bent.

Each section of the arch as it was placed was lined up, set a little higher than final elevation, and then securely pinned and bolted to the preceding section. When the shoes at the far end of the span had been placed on the forward pier and bolted to the masonry, and the sixth and closing section of the arch set, the sand-jacks were lowered, after which the joints of the arch ribs were made good and the bolts re-tightened. The ribs had been drilled in the shop and assembled in lengths of not less than three sections, as a result of which they fitted so well when erected that they caused no delay and required no reaming of the joints.

With the span completely swung the falsework was taken out and hoisted to the deck, after which the traveler placed the shoes for the next arch and proceeded with the erection of falsework and arch material.

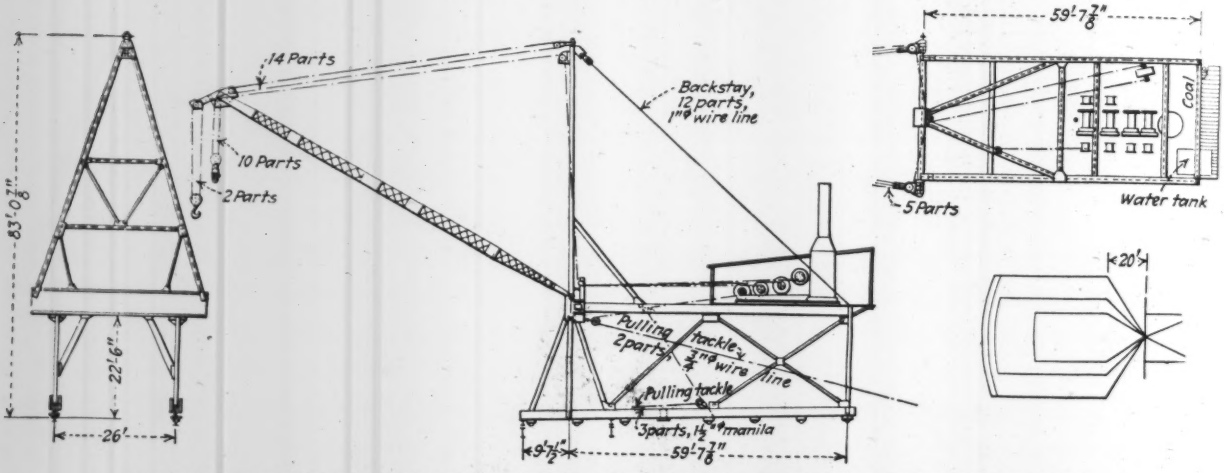
The falsework was found to be excellently adapted to the physical conditions of the site. It could be handled quickly and cheaply, was firm, did not slip or settle, and offered little resistance to the current.

Riveting of the floor system of the arch spans was begun before the falsework was taken out. Riveting the joints of the arch rib and the laterals was begun as soon as the arch was swung.

The ice in Lake Erie did not break up until unusually late in the spring of 1926, and it was not possible to start work on the substructure of piers 4 and 5 until after the ice had gone down the river. Due to the late start on these piers, the west or Canadian traveler erected not only span 6-7 but also the larger part of span 5-6. Thereafter it was taken down and shipped to the Buffalo side, where it erected the approach steel from pier B to the east abutment.

The span over the New York Central tracks (span A-B) was erected by a special gin pole. The girders of this span, weighing about 70 tons apiece, were each shipped in one piece and hoisted to place as units.

Rapid Completion—Erection of the various parts of the work was completed as follows: Spans A-1, 1-2 and 6-7, completed by July 1, 1926; superstructure west of span 6-7 and span A-B, completed by August 16, superstructure east of span A-B, completed by October 31; arch spans in river completed by November 15. The contractor's own men thus erected 7,800 tons of steel between April 15 and November 1.



THROUGH TRAVELER USED FOR ERECTING ARCH SPANS OF BUFFALO-FORT ERIE BRIDGE

The bridge was built for the Buffalo and Fort Erie Public Bridge Co., in general charge of Edward P. Lupfer, chief engineer, and William Russell Davis, consulting engineer. R. W. Cady was their resident engineer. The Bethlehem Steel Co. was the contractor for the fabrication and erection of the superstructure, and its engineers supplied the information on which this article is based.

Canada Plans Extensive Air-Mapping Program

The Canadian government has approved plans for extensive aerial mapping for development purposes in northeastern Manitoba and northern Manitoba and Saskatchewan. The plans involve the mapping, with the aid of aerial photography, 24,700 square miles of territory. The program includes an area of 12,000 square miles centering on the prospective water-power site where development is contemplated by the Flin Flon mine interests. One advantage of the survey will be to enable the finding of the best route for a power transmission line to the mine site, 60 miles to the southeast. An area of 6,000 square miles is to be mapped in northeastern Manitoba, north of Berens River, which will complete the mapping of the territory east of Lake Winnipeg to the Ontario boundary and facilitate the selection of pulpwood for the Manitoba Paper Co. The remaining territory will include 700 square miles proposed as a national park in northern Saskatchewan, and another area of 6,000 square miles northeast of Prince Albert.

Car-Ferry Landing at Milwaukee; Grand Trunk Ry.

Novel Design of Girder Framing Allows Hinged Landing Apron to Warp with Tilting of Ship—Pile and Frame Fenders

WITH the increase of its freight transfer system across Lake Michigan and to accommodate two new car-ferry steamers which have been put in this service between Milwaukee, Wis., and Grand Haven, Mich., the Grand Trunk Ry. has constructed at Milwaukee a new slip with a steel landing apron of improved design. The new steamers are 360 ft. long and have a draft of 17 ft. 3 in. with a full load of thirty cars on the four tracks. They have twin-screws, giving a speed of about 14½ m.p.h., the lake passage averaging six hours. A car-ferry steamer moored with its stern at the apron is shown in Fig. 1; on each side are the apron counterbalance systems. This view shows also the approach tracks. Two diverging tracks extend down the apron, from each of which another track is led off by a split switch, the four tracks registering with those on the deck of the steamer.

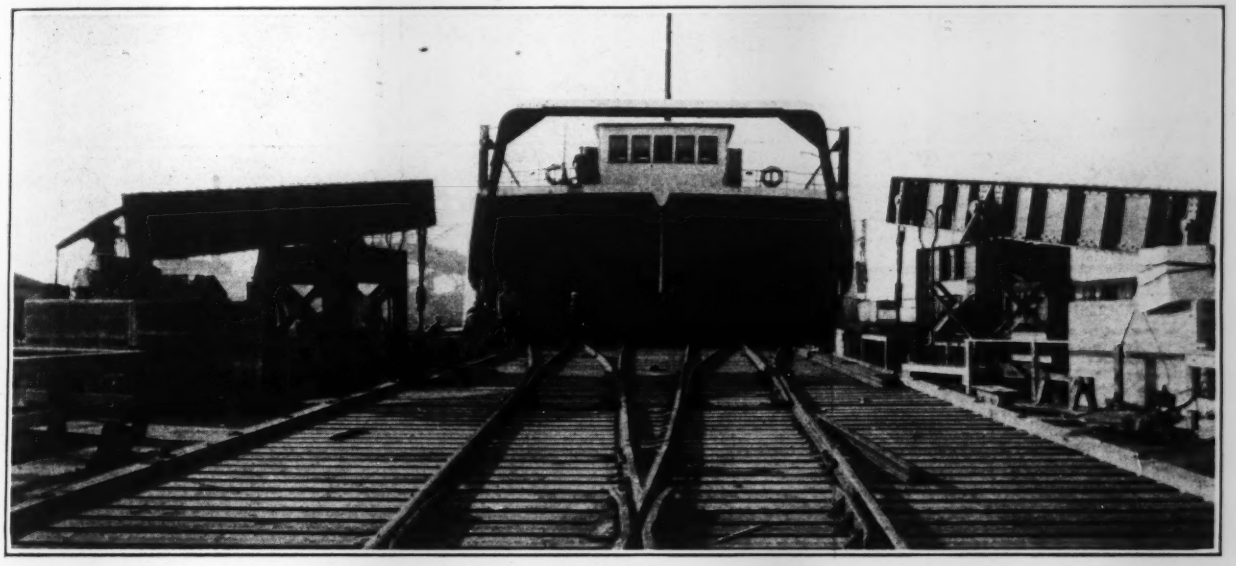


FIG. 1—CAR-FERRY LANDING AT MILWAUKEE; GRAND TRUNK RY.
Balance levers carry cross girder supporting outboard end of hinged landing apron.

Landing Apron—In the apron design, the special feature is a flexible arrangement of the steel framing which allows it to warp freely as the boat lists or tilts. For this purpose the main longitudinal girders have a direct bearing only (with no riveted connections) on the cross-girder which supports the dead-load of the apron near its outer end, while the transverse and lateral bracing is pin connected to the main girders so as to permit independent vertical motion of each girder. The general arrangement of the landing apron and the supports is shown in Fig. 2.

At several car-ferry ports on the Grand Trunk Ry. System, the steel landing apron which connects the shore tracks with the stern of the ferry steamer, is of a type which is adjustable for difference in elevation but consists of a rigid steel frame, so that it cannot accommodate itself to lateral variations. As a result there has been considerable difficulty in maintaining these aprons, due to the severe operating conditions occasioned by tilting of the steamers from side to side during the loading and unloading operations. In one case, the main cross girder which carried the dead-load of the outer end to the supporting counterweight beams was found to be buckled and a number of the rivets were sheared. It was thought that these conditions might be prevented by heavier and more rigid cross-girder construction, and repairs were made accordingly, but this method has not proved a satisfactory solution.

The problem was then approached from a different angle, and it was decided to provide a structural steel apron having the usual type of timber deck but made flexible in itself so as to warp freely and conform to the changing positions of the stern of the ferry. It was found that the following conditions had to be encountered: (1) A 6-ft. difference of elevation in the stern of the ferry, light and loaded; (2) during the loading and unloading operation there would be a tilting of the stern seat of about 3 deg. from the horizontal, causing a difference of elevation of 1 ft. between the two sides of the apron at the outer or ferry end; (3) the difference of elevation between water level and the base of rail of the ferry when loaded would restrict the depth of the steel apron; (4) water level varies about 1 ft. due to climatic conditions. To facilitate the operation of the apron in its extreme positions it was desirable to increase the length over that of the older 50-ft. apron at Milwaukee, and a length of 75 ft. over all was adopted.

Flexible Apron—In the new 75-ft. apron, Fig. 3, the general design consists of six longitudinal deck girders supported at the heel or shore end by large steel castings and phosphor-bronze trunnion bearings. At a point near the outboard or ferry end they are supported by a cross girder designed to carry the dead-load of the apron and suspended from a system of lever beams and counterweights to provide for the adjustment for elevation. In order that the longitudinal girders might

be free to move vertically with respect to each other, while the ends rested on the stern of the ferry, without introducing distortion stresses in the framework, no cross frames were used between the longitudinal girders. Instead, top and bottom lateral systems were provided and pin connected to the girders, thereby maintaining the girders parallel without restricting their independent vertical movement. This arrangement is shown in Fig. 3. Curved bearing plates form the seats of the main girders on the cross girder and provide for lateral rocking motion.

The cross girder was designed as a truss with solid web members, the upper chord passing through openings in the main longitudinal girders, and the bottom chord being provided with special bearing shoes to receive the load from the longitudinal girders. Stop blocks prevent excessive movement of the cross girder, since there is no rigid connection between this girder and the main longitudinal girders.

Operation of Apron—The apron is controlled by a double set of 3-ton single-drum electric hoists, each wound with double cable. These hoists are mounted directly on the counterweights and the cables are threaded over double sets of sheaves to small tension counterweights, each with a spring shock-absorber suspended at one side. The hoists are wired for remote control from a point near the ferry end of the apron. In the counterweights, holes are provided for placing scrap rail to adjust the balance. Normally, the apron will be held in a raised position by solenoid brakes built into the motor hoists. With a ferry steamer in the slip, the motor is reversed, permitting the apron to lower automatically until its end rests on the stern seat of the steamer. The motor is permitted to continue reversing until a pre-determined amount of slack is provided in the cable and is taken up by the auxiliary counterweight, which maintains a normal tension and prevents the cables from jumping off the sheaves. A limit switch then cuts off the current, and the apron rests on the stern of the ferry, tilting as the ferry tilts without straining any portion of the structure or mechanism. The apron is attached to the steamer by heavy latch bars.

After completing the unloading and loading of the ferry, the latches are released and the motors started. The apron, however, does not lift until the auxiliary counterweight bears on the projecting structural frame, which permits the hoists to lower the counterweight and thereby raise the apron. When the apron is back at its pre-determined height, a limit switch cuts out the current and the solenoid brakes automatically hold the apron in position. To provide against possible failure

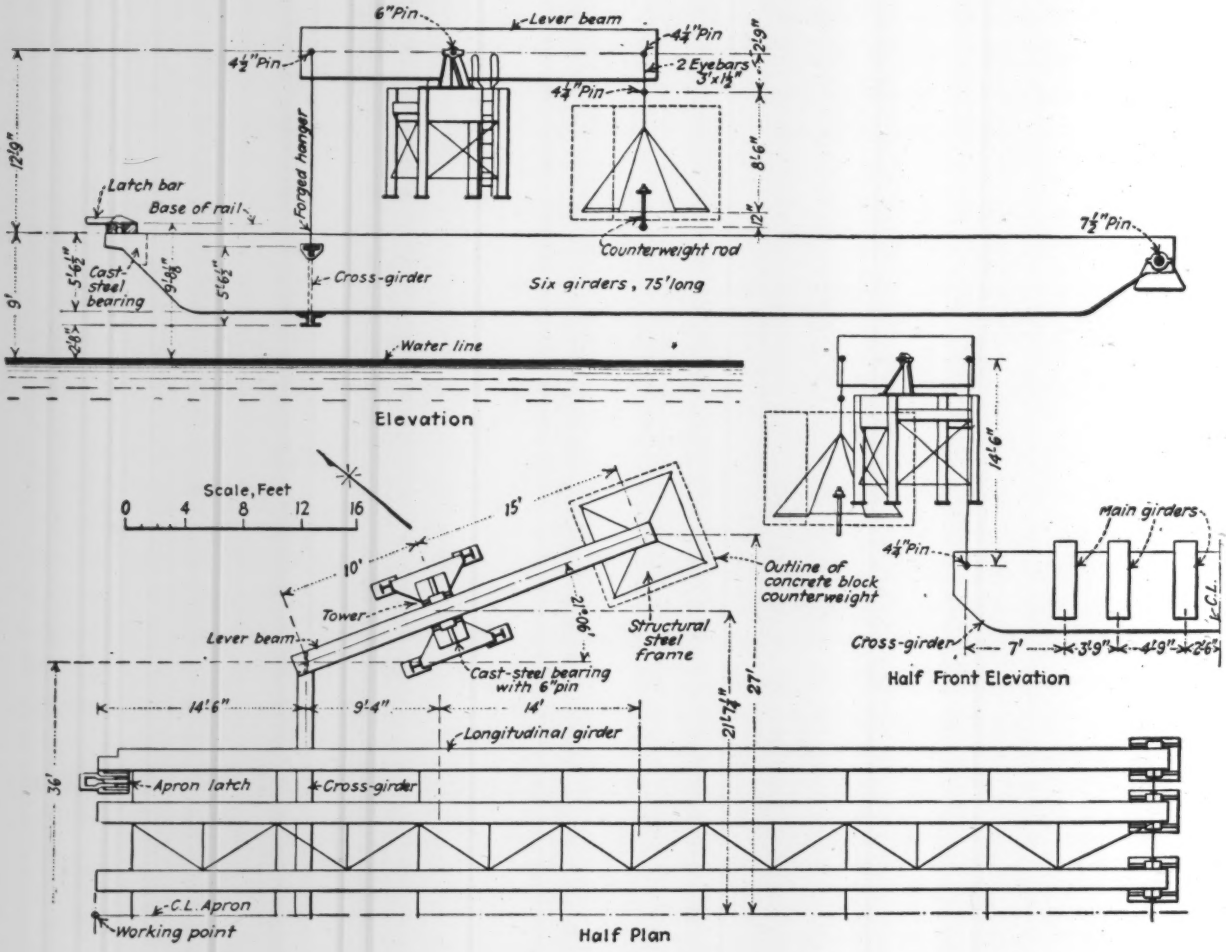


FIG. 2—GENERAL DESIGN OF CAR-FERRY LANDING FOR GRAND TRUNK RY.

of current, two 3-ton chain blocks are provided, to hook into the frame of the counterweight.

Fender Construction—As the steamer backs into its slip it is guided by fenders of pile clusters. When in position at the landing apron, its stern is held between two lines of piles with vertical plank sheathing. A novel design of pile and frame fenders is used, Fig. 4, which was first developed by this railway on its work along the Detroit River, where it has given satisfactory service for five years. Timber framing ties the upper portion of the fender together, leaving the lower portion to take care of the spring when the steamer strikes it. While the framing is expensive, the quantity of timber is relatively small and there is a material saving in the amount of piling required as compared with the ordinary type of pile cluster bound with chains or cables. The face of each fender is sheathed with vertical 4x12-in. oak planks fitted between old 56-lb. rails, as shown. Pile and timber piers support the steel towers which carry the lever beams. In all substructure work these parts which would be inaccessible after construction are of creosoted material, including the piles.

Engineers and Contractors—This Milwaukee dock improvement is in charge of J. A. Heaman, chief engineer, Grand Trunk Ry., at Detroit. The design was prepared under the direction of A. N. Laird, assistant engineer, and field construction was supervised by A. L. Ray, assistant engineer. Timber and dock work was performed by the Edward E. Gillen Co., Milwaukee, Wis. The steel apron was built by the Wisconsin Bridge & Iron Co., Milwaukee, Wis., and the mechanical and electrical equipment was furnished by the Palmer Bee Co., Detroit, Mich.

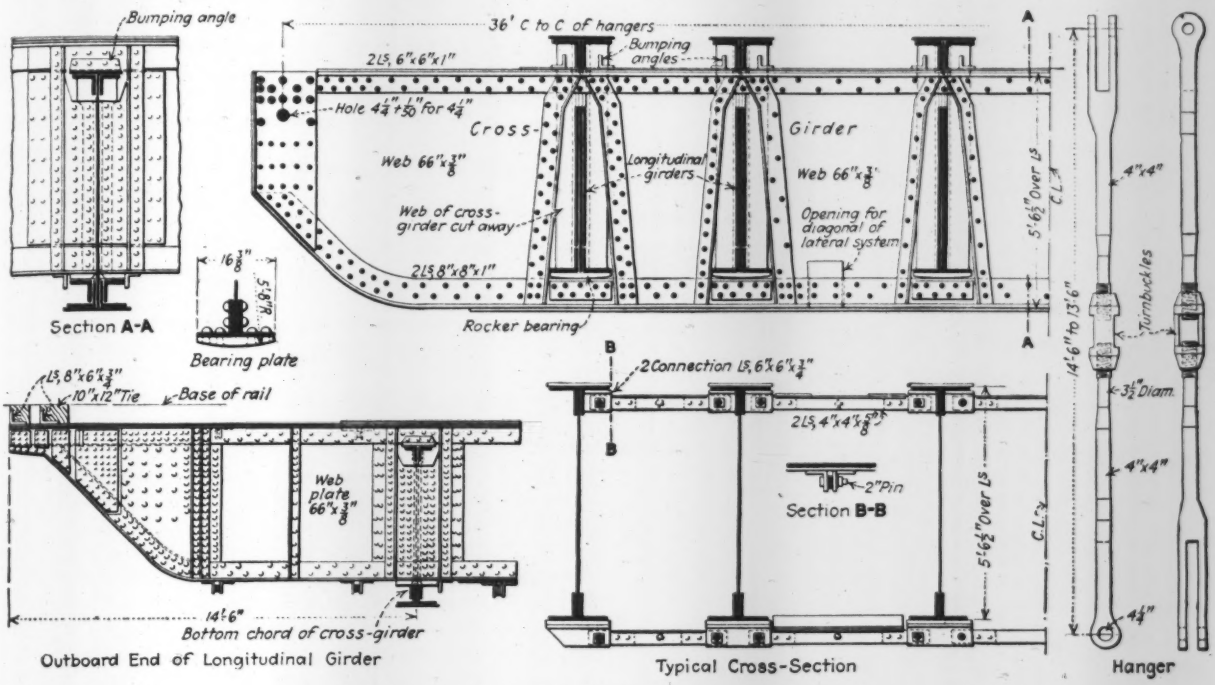


FIG. 3—FLEXIBLE FRAMING OF LANDING APRON

Note pin-connected lateral bracing and curved seats for longitudinal girders resting loose on cross-girder.

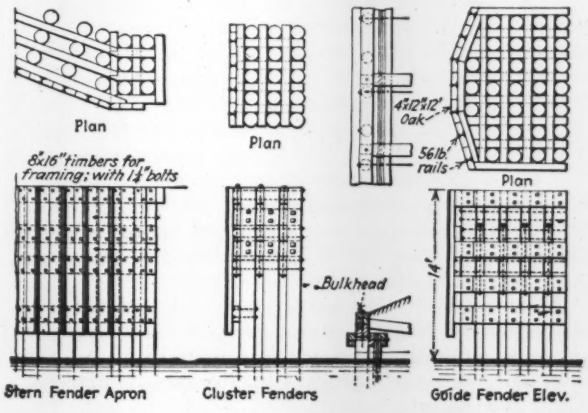


FIG. 4—PILE AND FRAME FENDERS

Highway Paving on Railway Bridge

A marked increase in automobile traffic on the McKinley bridge over the Mississippi River at St. Louis led to changes in the bridge deck to give increased traffic capacity and to separate high- and low-speed traffic. This bridge carries a double-track electric line for suburban and interurban service and two 14-ft. roadways outside of the trusses, a toll being charged for highway vehicles. In view of the growth of automobile traffic it was at first proposed to widen the roadways, which would have required extensive reconstruction. As a cheaper alternative it was decided to pave the track deck and to assign this for the use of automobiles, leaving the roadways for trucks and slow-moving vehicles. The paving is of creosoted blocks laid on planking carried by the floor system, some additional steel being put in to support the planking.

Causes of Concrete Pavement Deterioration

Relation of Structure, Materials and Foundations to Concrete Road Behavior Determined by Census of North Atlantic Highways

By J. S. Bixby

Division Engineer, Division of Highways, New York State Department of Public Works, Poughkeepsie, N. Y.

This text is made up from extracts from a long and extensively illustrated report made to the Association of Highway Officials of the North Atlantic States in annual convention Feb. 16-18, 1927, Atlantic City, N. J. The full report will be published by the New York State Department of Public Works.

THIS SURVEY covers the history, construction and present condition of 2,500 miles of concrete road in the New England states, New York, New Jersey and Delaware. In order to eliminate as far as possible such factors as traffic density and varieties of material, which would furnish an impracticable number of groups and classifications, and engineering control which is more or less indeterminate for old projects, this investigation has been made on broad lines and for large groups. The divisions adopted are: (1) Joint spacing; (2) aggregates and mixes; (3) reinforcement; (4) subgrade, and (5) slab depth.

Joint Spacing—Practice in the states being considered records the following spacing: Vermont 50 to 60 ft.; New Hampshire 50 ft.; Massachusetts 60 ft.; Rhode Island 100 ft.; New Jersey 56 ft.; New York 40 ft., and Delaware the day's run. The crack survey furnishes no evidence to warrant or support a joint spacing of less than 100 ft., as for roads of the same type combined cracks and joints are less for long than for short slabs. Fifty miles of 100-ft. slabs on only fair soil and with severe winter conditions average less lineal feet of combined joints and cracks after three to five years than average lineal feet of joints alone for pavement with slab spacing of 40 ft.

In any consideration of joint spacing, it must be remembered that additional joints mean additional expense, additional construction difficulties, and more planes of weakness built into the pavement especially susceptible to unequal heaving under frost conditions and to disintegration and corner breaking under truck impact, and that at no point in the pavement is dense and impervious concrete so difficult to obtain as at the expansion joint. Control of the slab edges is simple, while constant vigilance is necessary at the slab ends next to the expansion joint to avoid porous concrete which is difficult to detect and impossible to remedy.

Aggregates and Mixes—In this survey cross and diagonal cracking have been given considerable weight, but this measure of deterioration has not the same value for the old full-width pavements as for the modern panel type. In the former group this cracking is found to be irregular in character with wide openings not due entirely to age, while on the modern slab types diagonal cracks are greatly reduced and many of the cross cracks are fine, fairly straight, and approximately at right angles to the center line of road. Such cross cracks are simply contraction or bending joints installed by nature, and not a sign of weak or defective concrete.

Much more important and significant on the modern panel road are the diagonal corner cracks or corner breaks which definitely split off a small section of pavement, leaving an unsupported section of concrete which is almost sure to settle and disintegrate under traffic and take adjacent areas of pavement with it.

From the survey conclusions may be drawn that:

(1) No preference can be shown for natural or washed sands under proper control, but from a study of curves supplemented by examination of the individual road reports, sand is the aggregate which is most variable, and when not under proper control is the greatest factor in scaling and other forms of deterioration.

(2) In all cases less scaling is found on gravel than on broken stone roads. It appears that this is due to the greater ease of manipulation with gravel, thereby avoiding the building up of a surface mortar coat.

(3) Good materials and good workmanship will avoid scaling with any combination of aggregates.

(4) Average gravel concrete does not give the record of strength and durability shown for average broken stone aggregate, especially after serious deterioration is started. Up to the point where age or traffic weight begins substantially to overcome pavement resistance, gravel pavements in many cases show as good or better results than those constructed with broken stone. Average gravel aggregates are cited as it appears clear from separate studies not shown here that there is substantial variation in the suitability of gravel aggregates derived from different deposits.

(5) Scaling appears to consist of: (a) scaling due to concrete of poor quality, the sloughing away of the surface being merely the first step toward complete disintegration and failure of the pavement, or (b) what may be called true scale where an integral, thin mortar layer $\frac{1}{32}$ to $\frac{1}{4}$ in. thick flakes off leaving a shallow depression. The first class of scaling does not deserve extensive consideration, as recent experience shows pavement failures are avoidable with ordinary up-to-date supervision and control.

For true scale which appears on many apparently sound roads the following causes are submitted by the road reports: fine or dirty sand; coarse aggregates of large size; coarse aggregates ungraded; coated coarse aggregate; coarse aggregates with flinty surfaces; overmanipulation; late finishing; too much cement, and frosted surface.

If one or two simple conditions causing scaling could be demonstrated, which if avoided would prevent scale, engineers would feel much relieved. But no information derived from this survey justifies any such conclusion. While overmanipulation may be cited by many engineers as the principal cause of scaling on otherwise satisfactory roads, there appears to be no warrant for discarding the other conditions cited as contributing to the same result. In the light of present information it is recommended to avoid scaling that every precaution be taken to eliminate loam or similar material, to avoid materials and manipulation which will tend to produce a separate mortar coat above the main body of the slab, and to avoid finishing after the surface has taken an initial set.

Reinforcement—The survey indicates that the use of reinforcement is justified but there is no evidence that any reinforcement alone will save from rapid deterioration and eventual failure a pavement of inadequate depth or strength.

Reinforcement will not decisively affect cracking

which appears during the early life of concrete roads, but reports on thin roads indicate that reinforcement is a most valuable agent in preventing the widening and disintegration of these cracks, and the dislocation and destruction of broken corners. Action of reinforcement at cracks and corner breaks strongly suggests the use of dowels at least at transverse joints where uneven movement of the slab ends may cause destructive impact stresses.

There is no evidence that reinforcement efficiency is in direct proportion to the weight of steel used between the limits of 40 lb. and 120 lb. per 100 sq.ft. On the contrary, there are indications that reinforcement in the lower half of this range may be as valuable as the heavier types.

Subgrade—Over culverts cracking is general to such a degree that special care should be taken to counteract this condition. Possibly a short length slab, of heavier section than the balance of the road doweled to the adjacent slabs, would help this condition; but the persistence of these culvert defects after many years' recognition by engineers indicates that a positive remedy has not been found other than to sink the culvert so far below the pavement that its influence will not be felt. Unfortunately, this is not practicable in many cases. In the case of approach slabs to bridge abutments on new fill, extra thickness and reinforcement, with the bridge end stepped onto the bridge abutment, may bridge over approach fill settlement for many years. Unless this is done nearly all approach fills will show settlement enough to disturb approach slabs within six months or a year regardless of methods of fill consolidation, and additional settlement will continue for a long time.

Sections of road built over ledge subgrade, particularly on heavy grades, show excessive cracking. To counteract this a 6-in. gravel sub-base well drained, appears advisable, although instances are reported where even 6 in. of gravel carried through a rock cut have not protected the pavement from the destructive effect of water rising in the rock seams and from the change in subgrade entering and leaving the rock cut.

Several of the states report, on roads laid over old stone roadbeds or other rigid foundation, defects which show that this practice is dangerous. It seems advisable, if such foundations are to be retained, either to break up and reshape the old road metal or to provide a cushion layer of at least 6 in. of gravel or other porous filler to be placed between the old foundation and the pavement slab. Roads reported are not examples of resurfacing of concrete on concrete, but cases where varying rigid foundations of concrete or other type were disregarded in designing and preparing a uniform subgrade for new pavement. In general the survey warrants the following conclusions:

(1) Bad subgrades are a destructive agent in concrete as well as in other types of pavement. This is confirmed by experience in Delaware, which uses successfully pavement types and depths which are impracticable in other North Atlantic states.

(2) Gravel, cinders, or other porous filling at least 6 in. deep is recommended as the best remedy for wet or clay subsoils; but there appears to be a question as to the value of this treatment unless it is drained to the ditches by weeps or by laying the porous filling ditch by ditch.

(3) Reports agree that rock or non-uniform rigid foundation directly under pavement is a positive destructive agent.

(4) Standard practice to overcome successfully the destructive action of culverts and pipes near the surface, of abrupt subgrade changes, of approach fills to rigid abutments has not been established.

(5) The resistance of concrete pavement laid on poor subgrade but constructed with an adequate factor of safety is likely to postpone for many years any decisive or substantial evidence of the destructive action of bad subsoil, but unless counteracted by special treatment unfavorable subsoil action will become an increasingly important factor at some period in the later life of the pavement.

Pavement Thickness—Cracking and corner breaking were used as the indices of behavior in this census. From the records the following conclusions are drawn; Nothing on the pavement thickness curves disagrees substantially with the result of the Bates and Pittsburg tests of 1922 and the 1923 and 1924 Arlington tests.

If the Bates, Pittsburg and Arlington tests give a true indication of concrete road performance under actual highway conditions, and if this survey is sound, we have a critical concrete depth of approximately 7 in. for average and present conditions of traffic. But this is not all, for even though we may agree on a critical depth of 7 in. multiplication of evidence shows that pavement 1 in. thinner will not stand present truck traffic; and if all pavements substantially thinner than 7 in. are deficient, how can we give a 7-in. road slab a greater safety factor than unity if we consider the road slab as an engineering structure?

Seeking a safety factor of two on the basis of one for a 7-in. critical depth of pavement, the matter resolves itself into the relation between increase in pavement depth and its strength and stability and it appears from the best information available that we will not be far wrong in assuming that pavement strength varies directly as the square of the depth.

A pavement designed on the latter ratio is therefore certainly not radical or extravagant, and gives as a minimum a 10-in. concrete pavement to provide a safety factor of two based on a critical pavement depth of 7 in. This depth is recommended for all trunk lines where intense truck traffic and severe winter conditions may be expected. It is further recommended that no pavement less than 8 in. be constructed where severe winter conditions prevail at all, as traffic reports show that improved roads even in remote regions develop their own heavy trucking.

Ontario Hydro Reports Progress

The annual report of the Ontario Hydro-Electric Power Commission shows that during the fiscal year it had increased its power development from 808,398 to 928,032 hp. and strengthened its financial position. The total revenue amounted to $20,555,179, which, after providing for all fixed charges including the sinking fund, etc., left a surplus of $565,413. The rural service has been steadily extended and has now a total of 2,300 miles of which 750 miles were added during the year, the total number of farms supplied being 19,000. The total public investment in the entire system amounts to $203,442,759. The commission has a reserve fund of $24,751,411.

Isolated Sewer System for St. Paul, Minn.

Drainage and Sewerage for District in Uneven Country—Loose Soil—Tunnel and Open Cut—Contract and City Work

WITH the opening of new main highways entering St. Paul, Minn., there has come the development of an eastern outlying section which the city zoning plan had set aside for residential purposes, but the irregular topography of which makes such development expensive. Drainage and sewerage had to be provided, but as the conditions precluded any connection with the city's general sewer system, it was necessary to design an independent system having its own outfall. The project, known as the Phalen Park-Belt Line-Hazel Park sewer, was postponed from time to time on account of the high cost of the outfall sewer through the bluffs to the river, traversing broken and rugged topography in a glacial drift formation and without defined lines of drainage. Typical construction work is shown in Fig. 1.

This sewer system, Fig. 3, as finally planned in 1923, will serve an area of 6.6 square miles, with an ultimate prospective population of 70,000. The estimated cost is $2,100,000, of which the city pays $1,500,000 by a bond issue, as a general public improvement, while $600,000 is assessed on the property. On account of the cost and the varying character of the work the project was divided into eight sections, several of which were let by contract in 1924. On one section, largely in tunnel, the only two bids were so far above the estimate that the city council authorized the department of public works to construct it on the force-account system.

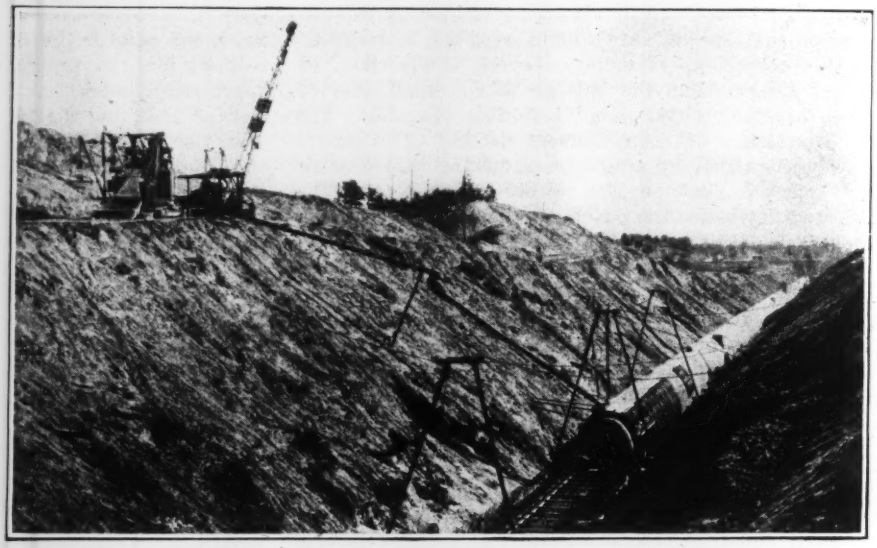


FIG. 1—BUILDING TRUNK SEWER IN 70-FT. CUT

The outfall sewer, 2,748 ft. long, is 9 ft. in diameter. There are 9,513 ft. of horseshoe section, 11 ft. 4 in. x 12 ft., with 750 ft. in tunnel; also 2,716 ft. of 9-ft. circular or equivalent horseshoe section, with 1,955 ft. in tunnel. The remainder ranges from 1- to 7-ft. circular or horseshoe section. For the large horseshoe section on a grade of 0.6 per cent, just before entering the 9-ft. outfall sewer, the capacity is 1,935 sec.-ft. or 0.51 sec.-ft. per acre. The outfall sewer under 80-ft. head will discharge 1,940 sec.-ft. or 0.46 sec.-ft. per acre. Without any head it will discharge 715 sec.-ft.

Construction of the large horseshoe section in a cut 70 ft. deep is shown in Fig. 1. Here the material is too loose to be suitable or economical for tunneling, and as the cut is in open country, its width was no objection. Excavation was done with a dragline machine working along the top of the cut and handling a bucket of 3 cu.ft. capacity. The slopes were about 1 on 1½ to 1 on 1¾. Typical sections of the concrete sewer are shown in Fig. 2. On part of the circular outfall section, a 24-in. tile drain was placed to carry drainage from the state fish hatchery. For the tunnel arch, brick or concrete was allowed, but concrete was used throughout.

With an average annual rainfall of 27 in. in this territory, the upper laterals were designed for a runoff of 1½ in. per hour. Much of this area has defined drainage, but as there is little accumulation of water, it has been assumed that the runoff will be comparatively light in view of the seepage into the glacial drift. Furthermore, the elevation of the main outlet is considerably lower than that at which the laterals enter, which allows an additional runoff factor of safety. On account of the difference in time of concentration of flow from the various laterals, the main trunk sewers were designed on a basis of 1-in. runoff per hour, decreasing to 0.6 in., this figure being based upon the entire drainage area, which includes waste land which will not be improved for years, if ever.

The large horseshoe section was adopted after considerable study of various sections, including semicircular arch, parabolic arch and rectangular sections. The type adopted has greater moment at the spring line and at the junction with the invert than some of the other sections considered, but this could be taken care of with proper reinforcement.

The reasons for adopting the section are: (1) It lends itself to both open-cut and tunnel methods; (2) the comparatively narrow invert as compared with the hydraulic capacity of the section lends itself to the easy scouring and cleansing of sand and gravel which are carried in from lateral sewers by heavy storms; (3) the vertical side up to the spring line lends itself well to sheeting methods, as it is possible to use bracing both just above the invert and above the spring line during construction.

On account of the irregular character of the ground and the necessity of short pieces of tunnel under streets and railroads, it was essential that the section adopted should be practicable both for open-cut and tunnel operations. Experience has shown that the section has worked out very well under both conditions. Steel inside forms were used, with wooden outside forms. For

the branches from 5 to 9 ft. in diameter or equivalent, the bidder was allowed to choose either a circular or horseshoe section. The latter, approximately 8x9 ft. (equivalent to 9 ft. diameter), was used for the two main laterals. For smaller sizes, the contractors generally elected to use the circular section with steel forms. Concrete pipe up to 6 ft. in diameter was used where conditions were favorable.

The last contract was completed in November, 1926, and the force-account job in January, 1927. John H. McDonald is commissioner of public works. Design and construction were under the supervision of George M. Shepard, chief engineer; E. S. Spencer was principal assistant engineer, and W. N. Carey was superintendent of construction, all of the department of public works.

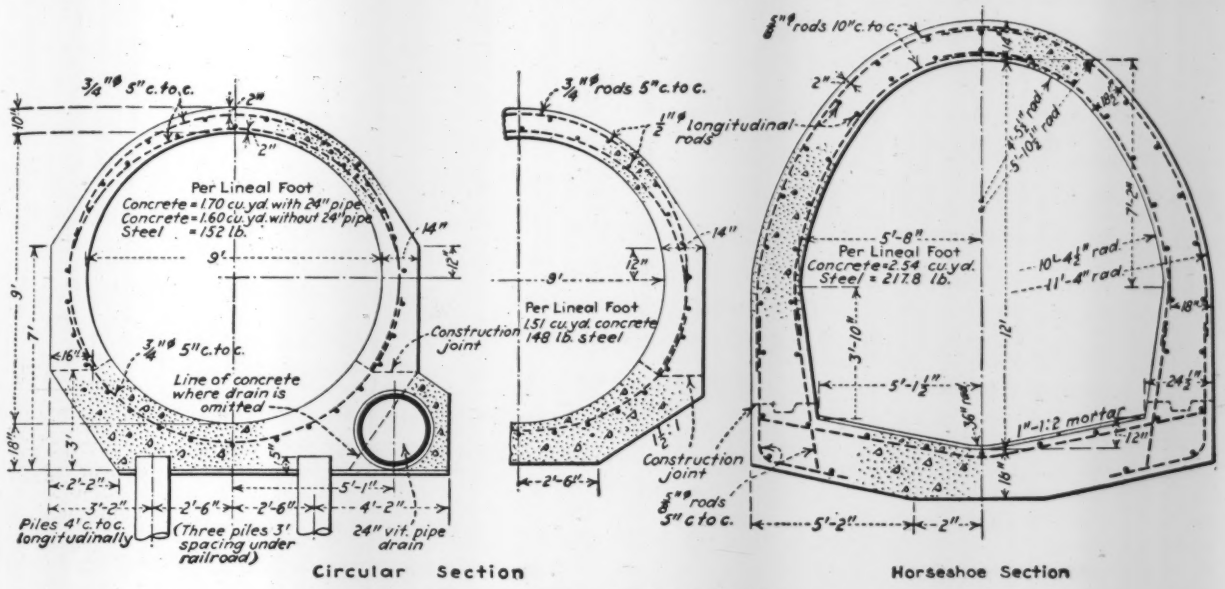

Per Lineal Foot
Concrete = 1.70 cu.yd. with 24" pipe
Concrete = 1.60 cu.yd. without 24" pipe
Steel = 152 lb.
Line of concrete where drain is omitted
Construction Joint
Piles 4' c. to c. longitudinally
(Three piles 3' spacing under railroad)
24" vit. pipe drain
Circular Section
Per Lineal Foot
1.51 cu.yd. concrete
148 lb. steel
Per Lineal Foot
Concrete = 2.54 cu.yd.
Steel = 217.8 lb.
1"-1:2 mortar
Horseshoe Section

FIG. 2—TYPICAL SEWER SECTIONS

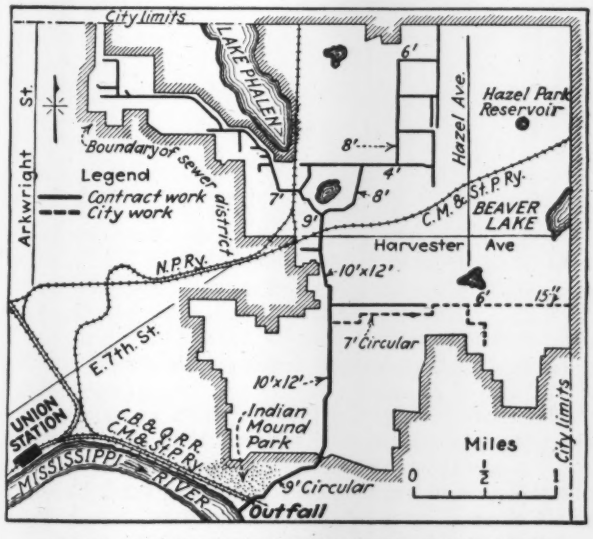


FIG. 3—NEW SEWER SYSTEM AT ST. PAUL, MINN.
District comprising area of nearly 7 sq.mi. will be served by new sewers under construction.

Thin Stone Surfacing Improves Earth Roads

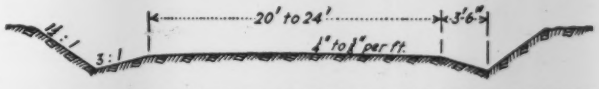
BY A. T. GOLDBECK

Director, Engineering Bureau, National Crushed Stone Association, Washington, D. C.

Extract from an article in the "Crushed Stone Journal" for April, 1927, of the National Crushed Stone Association.

THE earth road to be improved probably will need reshaping to a proper cross-section and the drainage requirements should be carefully studied and provided for. A cross-section which will give good results is shown. A very flat crown is suggested, not to exceed ¼ to ⅜ in. per foot. It is to be remembered that the finished road when properly maintained will accommodate high speed traffic and due attention should therefore be given to both line and grade as well as to super-elevation on curves.

After the subgrade has been prepared, the surfacing material is spread at the rate of approximately 1,000 tons per mile for the first application. The size and kind of material vary in different localities, but with crushed stone the best results have been obtained with an initial application of material passing a 1-in. screen and retained on the No. 10 sieve. After the stone is spread out of dump trucks, it is bladed to the sides of the road in windrows leaving a layer only 1 in. in thickness on the subgrade. Traffic may



SUBGRADE READY FOR LIGHT SURFACING OF STONE

be immediately turned on the road and as weak places develop, additional stone is dragged in from the windrows or piles along the sides and in this manner the weak spots are kept filled and the surfacing is thoroughly compacted.

A smooth surface is maintained by dragging and the excess material is drawn in from the sides as required. It is necessary to keep a thin loose layer on the surface and for this reason it is undesirable that the stone contain any clay or material which will cause it to bond, for such material cannot be dragged successfully and rapidly develops potholes; nor must the layer of loose stone be too thick for this becomes dangerous for traffic. Not over 1 in. of uncompacted material is desirable as a surface layer. In time, as more and more of the stone compacts and the loose material is drawn in from the sides, the road crust gradually builds up in thickness and becomes more and more efficient for carrying loads.

Prediction of 28-Day Strength of Concrete

Acceleration, by Steam, of Test-Cylinder Strength Is Basis for One Prediction, and Comparison with Fineness Modulus or Gradation of Sand Is Basis for Other

Predicting 28-Day Concrete From 2-Day Tests

By Donald O. Nelson
District Engineer, Truscon Steel Co.
Portland, Oregon

and

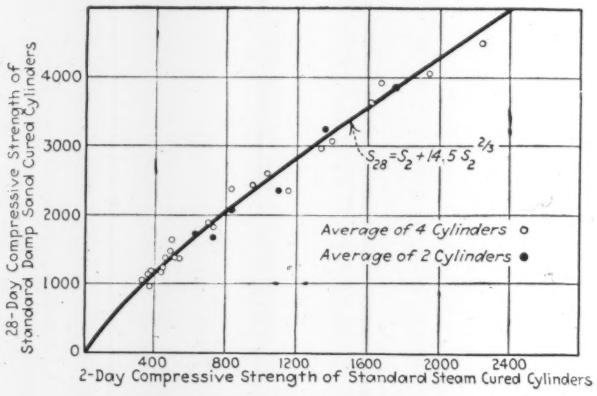
Frank E. Nichol
Instructor in Civil Engineering,
University of Minnesota

A PREDICTION curve has been developed from tests on over 220 concrete cylinders, enabling the determination of the 28-day strength of concrete in two days. The development of this curve is based upon a comparison of the strengths obtained in tests on two sets of concrete cylinders, one set being cured in the usual manner for 28 days and the other being accelerated with steam.

The apparatus used in the steam curing consists of a closed steam chest connected with a steam main through a regulating valve. A hot water line also enters the steam chest and is connected with a perforated pipe hung over the tray on which the test cylinders stand. A steam trap carries off the water from the spray and condensate.

Test cylinders 6x12 in., were made in the approved manner and allowed to cure in their forms, covered and at room temperature, for 24 hours. The cylinders were then removed from their forms and placed on the tray in the steam chest and covered with sacking. The hot water was then turned on so that a light spray fell on the cylinders, the chest was closed tight and the steam turned on. The regulating valve was set to maintain a pressure of 15 lb. per sq.in. After 24 hours the cylinders were removed from the steam chest and allowed to cool at room temperature for about two hours, when they were tested in the standard manner. The cylinders were made up in batches of four, two of which were cured and tested as above described and the other two cylinders were stored in damp sand at 70 deg. F. and tested at 28 days. The results of these tests are plotted in the accompanying curve. Points represented by a circle are the average of four steam-cured cylinders and four damp sand cylinders, which were made in two batches on different days, and the points represented by a square are the average of two cylinders of each. The curve shown was then drawn representing the average of the points and the equation $S_{28} = S_2 + 14.5\, S_2^{2/3}$ developed, in which S_{28} and S_2 represent respectively the 28- and 2-day strengths. The maximum variation of the experimental results from the graph of the equation developed is 18 per cent while the average variation is 6 per cent.

The cement used in these tests was a blend of three of the best known cements on the Minneapolis market. The sand and gravel used were washed and screened and were from a local pit. They were of good grade and of the ordinary range in sizes. It is to be noted that the curve is based on tests of a single cement blend, a single sand and a single gravel but it is believed that the results obtained by the use of other standard cements and other types of aggregate will not vary greatly from the results here obtained. However, before this method of predicting strengths can be universally applied a large number of tests should be run with other cements and aggregates. It does seem though to offer an effective means of predicting 28-day strengths at two days when laboratory equipment is available in the vicinity of the job.



CURVE FOR PREDICTING 28-DAY STRENGTH FROM 2-DAY TESTS

The experiment was performed by the writers, in the structural laboratory of the engineering experiment station of the University of Minnesota. Prof. John I. Parcel is the head of the structural division of the civil engineering department; and Asst. Prof. M. B. Lagaard, now with the Portland Cement Association Research Laboratory, was at that time in charge of the experimental work.

* * *

Fineness Modulus No Measure of 28-Day Strength

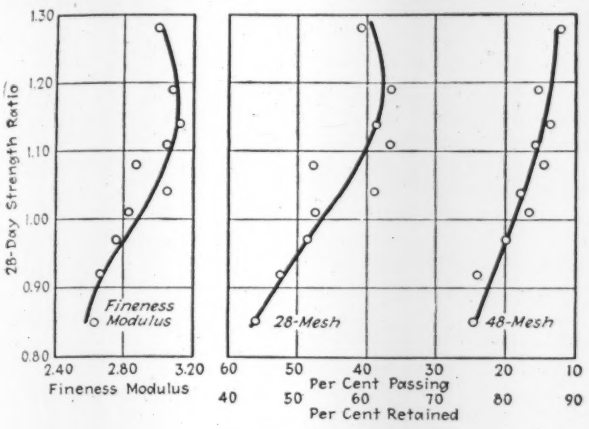
By H. O. Olson

Division Materials Engineer, Tennessee Department of Highways, Nashville, Tenn.

A STUDY of the results of routine tests made on different sands in the laboratories of the Division of Tests and Investigations, Tennessee Department of Highways, shows no relation to exist between the fineness modulus or gradation of sand and the strength developed by that sand in tension in a cement mortar at the age of 28 days.

The results of several hundred tests on sands from about twenty different producers were available for this investigation. These tests ranged in number from one to over one hundred on a particular sand, but only sands covered by a minimum number of twenty-three tests were used.

The data in Table I show the strength ratios of the different sands compared with standard Ottawa sand. This ratio was used as a basis for comparison rather than the actual 28-day strengths in pounds per square inch, as the tests covered over a year's time and it



TYPICAL STRENGTH-RATIO CURVES

Ratio of compressive strength of mortar made with a representative sand to mortar made with Ottawa sand.

tended to eliminate any differences due to variation in the strength of cements used.

A study of the individual sands was then made by taking the average tests in groups of ten and tabulating the data for each sand. The data as given in these tables were represented graphically, a chart for one representative sand being shown herewith. In this chart the strength ratio is plotted on the vertical scale and the fineness modulus and the gradations plotted on the horizontal scale. Only the gradation curves for the 28- and the 48-mesh strength ratios were plotted. The curve at the left expresses the average relation of strength ratio to fineness modulus and gradation. If this relation is accurate and reliable, any single test can be plotted, and the point should come fairly close to the curve. A number of tests were made and it was found to be the exception rather than the rule that the point would fall near the curve. These curves show that a larger fineness modulus, or a coarser sand, sometimes indicates a greater strength ratio for that particular sand. A determination as to whether the strength would fall above or below a certain per cent was made. For this purpose, the 100 per cent line was used as datum, as this is the per cent strength ratio commonly specified in tests of sand. A tabulation of exceptions is given in Table II. An examination of the tabulated data immediately showed

TABLE I—RELATION OF STRENGTH TO FINENESS MODULUS

Fineness Modulus	Strength Ratios of Test Sand to Ottawa Sand Minimum	Maximum	Number of Tests
1.70 to 1.79	0.78	1.05	4
1.80 to 1.89	0.83	0.83	1
1.90 to 1.94	0.72	1.04	6
1.95 to 1.99	0.82	0.97	7
2.00 to 2.04	0.72	1.09	8
2.05 to 2.09	0.83	1.00	5
2.10 to 2.14	0.73	1.07	11
2.15 to 2.19	0.88	1.04	12
2.20 to 2.24	0.88	1.12	13
2.25 to 2.29	0.88	1.18	15
2.30 to 2.34	0.77	1.17	25
2.35 to 2.39	0.89	1.16	15
2.40 to 2.44	0.75	1.23	41
2.45 to 2.49	0.79	1.22	34
2.50 to 2.54	0.85	1.22	34
2.55 to 2.59	0.74	1.23	30
2.60 to 2.64	0.87	1.40	21
2.65 to 2.69	0.93	1.48	23
2.70 to 2.74	0.95	1.43	22
2.75 to 2.79	0.92	1.23	18
2.80 to 2.84	0.93	1.21	6
2.85 to 2.89	0.73	1.25	18
2.90 to 2.94	0.96	1.40	9
2.95 to 2.99	0.86	1.39	10
3.00 to 3.04	0.92	1.23	9
3.05 to 3.09	0.94	1.20	8
3.10 to 3.14	1.01	1.22	8
3.15 and up	0.98	1.42	21

that there was no relation between the fineness modulus of sand and its 28-day strength ratio as compared to standard Ottawa sand. Table I shows that for any fineness modulus, strength ratios of a wide range are obtained. The curve for the different sands shows the same range in strength ratio, from about 80 to 125 per cent. Thus the range of fineness modulus or gradation varies considerably with the different sands, one having a fineness modulus range from 2.01 to 2.50, while another, with a nearly parallel strength ratio range, has a range of fineness modulus from 2.63 to 3.12. It is readily seen that samples of the two sands having equal strength ratios will differ radically in fineness modulus values.

An attempt was made to predict strength ratio from the fineness modulus and gradation of the sand. Only about 30 per cent of the tests showed the actual strength ratio to be within 5 per cent of the predicted strength ratio. This proportion is so small that it is obviously absurd to try to predict strength from a fineness modulus or gradation even when a large number of tests on that sand have been studied. To try to predict strength from fineness modulus with a sand about which nothing is known would be still more futile.

TABLE II—PER CENT OF EXCEPTIONS

Sand No.	Fineness Modulus	28-Mesh	48-Mesh	28- and 48-Mesh
1	26.7	26.7	33.3	18.9
2	42.2	37.5	30.0	22.5
3	26.7	22.2	24.4	16.7
4	30.0	28.0	26.0	20.0
5	17.4	17.4	26.1	8.7
6	31.0	32.0	29.0	13.0
Average.....	29.0	27.3	28.1	16.6

Although the actual strength could not be predicted, it was thought possible that a prediction could be made as to whether the strength for any given fineness would fall above or below the 100 per cent line. The results of this attempt are taken from Table II. Using fineness modulus as a criterion, the chances of correctly predicting whether the strength ratio will fall above or below the 100 per cent datum average 71 in 100. Using respectively the 28-mesh curve, the 48-mesh curve, and both curves, they averaged 72.7, 71.9 and 83.4 in 100.

Even these results, although considerably better than those for predicting the actual strength, are far from pleasing and it is doubtful whether it is worth while to try to predict any tension tests results from fineness modulus or gradation.

A summary of conclusions might be stated as follows:

(1) The fineness modulus or gradation of a sand is no indication of its 28-day strength ratio as compared to standard Ottawa sands. This might be caused by either the fineness modulus not being a true indication of the quality of the sand or by the 28-day strength test not being a true indication of the strength of the sand, or both.

(2) Considering only one brand of sand, a greater fineness modulus or coarser gradation sometimes gives a greater 28-day strength ratio.

(3) While a greater fineness modulus or coarser gradation sometimes gives a greater 28-day strength ratio, there are so many exceptions that it is impossible to predict 28-day strength ratio from the fineness modulus or gradation, even with a known brand of sand.

(4) The per cent passing the 28-mesh sieve or the 48-mesh sieve has more to do with the strength of a sand than the fineness modulus.

Raising and Widening West Market Street, Warren, Ohio

Main Artery Widened 20 Ft. and Grade Raised Above Floor Level, Necessitating Alterations in 51 Buildings

By W. S. Harvey
City Engineer, Warren, Ohio

WEST MARKET ST. is now the main artery of travel through the city of Warren, Ohio, from Sharon, Pa., to Akron and Cleveland, Ohio. Previous to the widening improvement described in this article, traffic to and from these points diverted itself for the most part along East and West South St. (Fig. 1) due to the fact that the portion of West Market St. between the Mahoning River and West South St. was narrow, low-lying and the asphalt block pavement was in very bad condition.

At the time of the Ohio floods of March, 1913, the

FIG. 1—CENTRAL PART OF WARREN, OHIO, SHOWING STREET WIDENING AND RAISING LOCATION

Mahoning River, at Warren, rose to 18 ft. above normal, overflowed both banks, and caused considerable damage to West Market St. and abutting property. Since then the improvement of West Market St. has been considered by the city council at various times, but action was postponed owing to the inability to arrive at a definite agreement with many of the property owners on compensation for damages. On Jan. 2, 1925, legal steps were begun for widening the street, and late in the following September contracts were let. These included a new sanitary sewer, a cast-iron water main on each side of the street, raising the grade of the street, constructing a new pavement, and raising, moving and remodeling various buildings.

The widening and raising begins just across the Mahoning River from the center of the city (Figs. 1 and 2) and extends for about 1,600 ft. on West Market St. A spur about 400 ft. long on Buckeye St. was raised to the new grade and paved with a new concrete base and brick wearing surface with asphalt-filled joints. The original width of West Market St. was 60 ft. between property lines with the 30 ft. between curbs paved with asphalt block on a rolled slag base. The new width of the street between property lines is 80 ft., and between curbs, 54 ft., paved with vitrified brick on a 6-in. concrete base. The 20-ft. widening was effected by taking 10 ft. from the property on each side of the street from the bridge to Buckeye St., but from Buckeye St. to the intersection with W. South St., the widening tapers to 0 on the south side and increases to 23 ft. on the north side (Fig. 2). Buckeye St. was not widened. The land for the widening was deeded to the city by the individual property owners.

The project necessitated entering into agreements with the owners of 51 buildings, of which number 24 accepted a cash settlement. The contract for the raising and moving covered 27 buildings and after the signing of the contract the owners of 5 buildings reached a settlement with the contractor and undertook to have their work done privately. The remaining 22 buildings in care of the contractor were classed as follows: 7 frame (residences); 6 frame (business); 2 concrete block (business); 5 brick (business); 2 frame (churches). The agreements with building owners were reached as follows: When estimates were being prepared for the raising and moving of the various buildings, each property owner was interviewed by certain city officials and the requirements of each property owner were inquired into. These requirements were listed and specifications and estimates drawn up accordingly. Each property owner was then given the opportunity of either accepting the estimated amount for the work or having the work done by the city's contractor. In case the owner agreed to accept the money offered he was paid such amount as liquidated damages and the land necessary for the widening was immediately deeded to the city. If the money was not accepted the city was authorized by the property owner to include the work in the city's contract. Agreements were made between the property owner and city in every case.

The work of raising and moving buildings was commenced Oct. 5, 1925, and proceeded with through the winter, the major part of the winter work being devoted to the frame buildings. This consisted of raising the buildings to grade, building up basements to the new elevation, and constructing new concrete floors. All gas, water, light and sewer connections were maintained while the raising operations proceeded. During the short time occupied in resetting the furnaces, heat was obtained, for the most part, by gas heaters. All frame business and residential buildings were occupied during the progress of raising and moving, with the exception of one building which happened to be vacant at that time. The brick business buildings were vacated owing to the inconvenience resulting from cutting off the brick fronts and rebuilding after raising. One building of ash concrete block with brick front was used as a showroom for plumber's supplies, with a large workshop in the rear; business was carried on in this building continuously.

The construction of a 30-in. sanitary sewer on Buckeye St. was commenced Oct. 17, 1925. This forms part of a future trunk sewer which will be constructed at a later date, and will cross the Mahoning River as a siphon. It was considered advisable to construct this section of the 30-in. sewer with this improvement to avoid breaking through the new pavement and fill when the trunk sewer is constructed.

The location of this section of West Market St. with respect to the Mahoning River made the question of storm drainage a comparatively simple and inexpensive matter. A 12-in. storm sewer was laid along the south side of the street and under the future sidewalk. On Sept. 30, 1925, work was commenced on the laying of

two cast-iron water mains, a 6-in. on the south side of the street, and an 8-in. on the north side. All the lead water services and 6-in. house sewer services were laid to the new property lines by the paving contractor and connected up by the contractor for the moving of buildings. The old 8-in. cast-iron water main was allowed to remain in use, but all services were shut off and connected to the new mains; gate valves were installed so that this old main can be shut off at any time. Although this old main has been in service for 37 years, it was found on inspection and under test to be in excellent condition and still capable of affording many years' service.

There was a 3-in. gas line on the south side of the street, and a 2-in. line on the north side, but as soon as the filling of the street was completed, two new 3-in. lines were laid, 4 ft. from the curb, one on each side of the street, and connected to the feeder on West South St. After these new lines were laid, all new services were installed, and old lines and services shut off and ends capped.

A provision in the paving contract allowed for the relaying of all stone and concrete sidewalk found in good condition; consequently, about 70 per cent of the existing walk was removed from the site, having previously been numbered and identified as to location.

After completion of the preliminary work just outlined, the filling of West Market St. and Buckeye St. was commenced Nov. 28, 1925. This fill was made with granulated furnace slag purchased locally and loaded into the paving contractor's trucks at a cost of 35c. per cu.yd. The contract provided for continuous rolling of this fill with a 10-ton roller and, in order to arrive at the most complete compression, the roller was applied to various depths of fill, which resulted in the depositing of the layers as nearly as possible 12 in. thick. The maximum depth of fill to new subgrade was 7 feet.

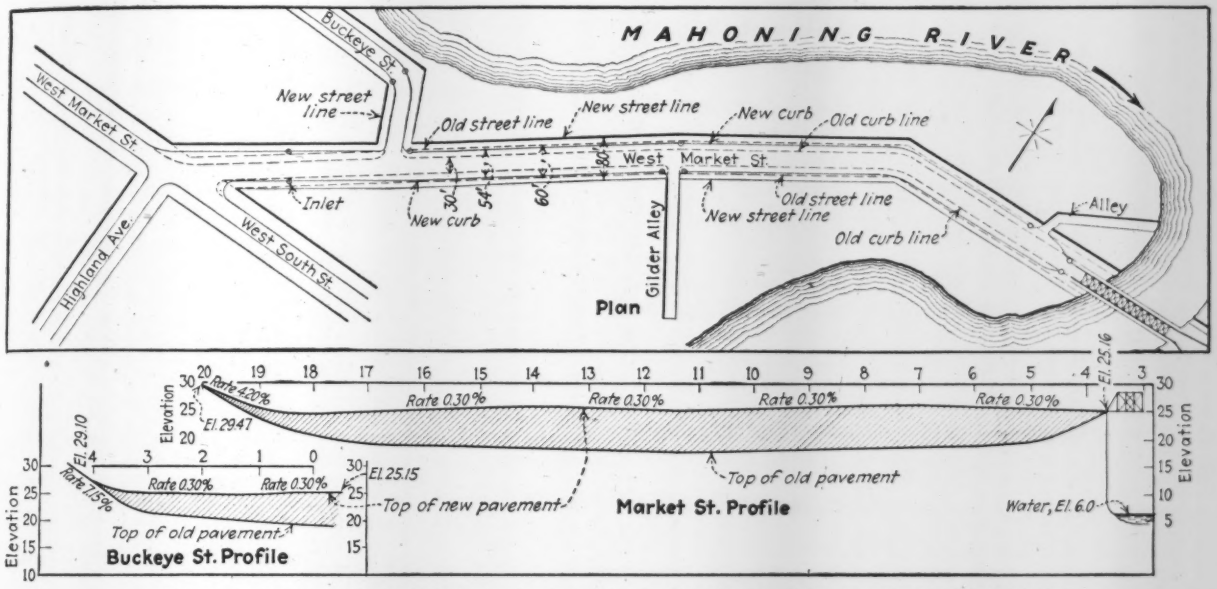


FIG. 2—PLAN AND PROFILE OF STREET WIDENING AND GRADE RAISING AT WARREN

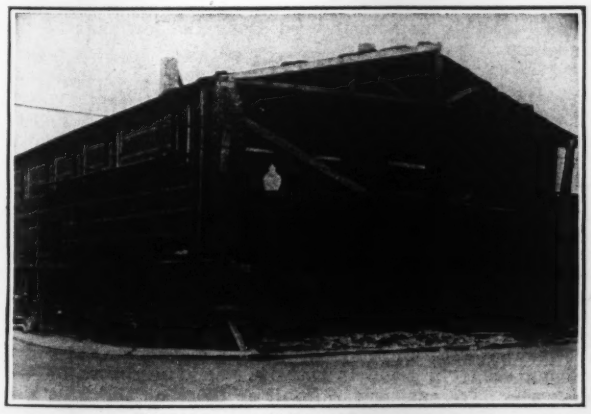


FIG. 3—BUILDING ALTERATION DUE TO RAISING AND WIDENING WEST MARKET ST.
Garage and showrooms raised 5 ft. 8 in. and angular piece cut off front.

From actual test, it was found that on this grade of granulated slag a shrinkage of 35 per cent had to be allowed for by the contractor, as the contract provided for the fill to be measured in place after consolidation, for which the bid was $1.20 per cu.yd. rolled in place, and as calculated from the cross-sections.

Much of this fill was deposited in freezing weather, and although the slag was delivered direct from the bins and hot, it was found that the preceding layer did not thaw out, and pockets of snow and ice remained and would remain for a considerable time and cause settlement. On this account, rock salt was applied between each frozen layer to guard against any possibility of future settlement. During the process of filling, traffic was permitted to pass over the street, which aided considerably in consolidating the fill.

Enough fill had been deposited and rolled by Feb. 6, 1926, to permit construction of the new pavement, but the fill was then allowed to stand and the street still kept open to traffic until May 19, 1926, when the setting of the new curb of Berea sawed stone was proceeded with. West Market St. was originally constructed with combined curb and gutter, which was not removed, while Buckeye St. was constructed with sawed-stone curb which was still in good condition, and was

therefore removed and reset on the newly raised street. All circle curb was of gray granite from North Carolina.

Before proceeding with the pouring of the concrete base, several test holes were dug through the slag fill to the old pavement. It was found that it was completely thawed out, and was thoroughly compressed, so much so that it was hard work to loosen the slag with picks. On June 5, 1926, the pouring of the concrete base was commenced at the north end of Buckeye St., which street is 30 ft. wide between curbs. The base is 6 in. thick, of 1:3:5 concrete, and was poured east and west on West Market St. by means of two batch mixers placed side by side, thus distributing the concrete from curb to curb. The wearing surface consists of 4-in. Bessemer paving blocks laid on a cushion of granulated slag 1 in. thick after rolling. The joints were poured with asphalt.

As stated elsewhere, the contract provided for the relaying of all stone and concrete sidewalk found in good condition. However, the walk was only 6 ft. in width, whereas, after widening, the space available for sidewalk purposes was 13 ft. wide. On this account, the old walk was relaid in such position as to leave a space 2 ft. wide from the back of the curb; by so doing, pedestrian traffic was kept a reasonable distance from the front porches of residences, while the 2-ft. space was utilized for street lighting cables. At all business buildings, new concrete walks have been laid for the full width, and electric conduit laid at the back of the curb. As the residences give away to business blocks, these walks will be replaced by new walks 13 ft. wide.

The cost of the work thus far described was $303,400, of which $228,000 was paid by the city and $75,400 by property owners. This was distributed as follows:

	City Share	Property Owners' Share	Total
Raising and moving buildings, damages and settlements	$141,000*	.....	$141,000*
Fill and paving	79,000	$65,000	144,000
Sanitary sewers	4,500	3,400	7,900
Water mains	3,500	7,000	10,000
	$228,000	$75,400	$303,400

* Damages amounted to $40,019.

Since the improvement was completed an ornamental street lighting system has been installed, at a cost of $6,000, to be met by the property owners. This brings the total outlay up to $309,400, all of which is met, in the first instance, by the issue of city bonds.

Regional Planning in England and Wales

There are now 42 joint town planning bodies in England and Wales, including over 600 local authorities with about 6,250,000 acres under their jurisdiction. These figures were given by G. L. Pepler, Town Planning Department, Ministry of Health, in a paper abstracted in the London *Surveyor*, Feb. 27, 1927, from which the following sentences are taken: "Road proposals and broad zoning were important features in all regional schemes, and in one, at least, a joint sewage disposal [project] was being tackled. The proposed definition of urban centers by belts of open land (in the Manchester region) was a notable item of regional policy. Recently considerable prominence has been given to the disadvantages and extravagance of straggling development, and to the importance of keeping urban centers compact and preserving their rural surroundings."

Irrigation and Flood Control in the Southwest

Tri-State Flood Problem of the South Canadian River — Irrigating the Texas Plains—Methods of Protection from Flood

SOME of the aspects of land development, land protection and flood control problems of the Southwest are outlined in the following brief abstracts of papers presented at the annual meeting of the National Drainage Congress at Amarillo, Tex. All these papers were prepared before the present flood in the Mississippi Valley.

* * *

Bank and Shore Protection Works

BY FRANK D. TOMSON
Lincoln, Neb.

TO THE engineer, the control of flood waters presents a problem admitting of solution and I recommend that the National Drainage Congress take up this subject, laying the ground-work for the final solution of a problem that is national in its scope and imperative in its importance. In the Mississippi and Missouri valleys I have observed always an impression that the streams of flood stage were beyond human ability to control, yet I have observed also during the past few years the ease with which these river channels are held intact and in place. The Missouri River has been accounted generally as a ravaging stream, changing its channel in many places when running at flood stage. But the application of a simple method causes this mighty river to deposit the silt it carries at the very points where its tendency has been to erode the banks, and causes it at the same time to scour a deeper channel in a more direct course downstream. Thus, two great interests are served, the protection of property and the making of navigable channels. This same method is being used also along lesser streams, not navigable, to protect private property, highways, bridges and railroads.

An effective method under certain conditions is the installation of pile diking at various points on the Mississippi and Missouri rivers. A 3,500-ft. dike will be placed at Liberty Landing, 75 miles below St. Louis; and two dikes of 2,200-ft. at Lexington and Atherton, on the Missouri River. The piles range from 40 to 65 ft. in length, with 20 ft. penetration, leaving normally 10 ft. above mean flow level. Along the Gulf coast are vast areas capable of development, but a drawback has been the lack of protection from tropical storms. The enterprise of Gulfport, Miss., and neighboring places has resulted in the building of a seawall many miles in length. This wall extends 11 ft. above and 10 ft. below mean tide. Such protecting wal's may stretch eventually along the shore line of the gulf, around Florida and northward along the lowlands of the Carolinas.

* * *

Irrigation of the Great Plains

BY A. LINCOLN FELLOWS
Irrigation Engineer, U. S. Department of Agriculture

IN the development of the Great Plains region, crop-growing gradually encroached upon the grazing interests until so-called dry-farming became general and more and more efficient. But as the open ranges have become a thing of the past, the settlers are finding that business must be carried on upon their own lands, that living is becoming more costly and that there is no longer the opportunity of going on to new agricultural lands. At the same time they realize that the rainfall is in general inadequate to permit raising crops in competition with their neighbors on the east who have sufficient rainfall or those on the west who are applying supplemental water scientifically.

In this discussion we are not interested directly in the entire region, but rather in the sub-humid or semi-arid portion lying between the arid lands on the west and that district on the east which has such rainfall that irrigation

would hardly be considered as yet, except for the more intensive phases of crop production. This sub-humid zone lies between the lines of 30-in. annual rainfall on the east and 20-in. on the west. Considering warm weather precipitation only, since this mainly determines the crops, these limits become the efficient precipitation lines of about 21 in. and 14 in. respectively. Evaporation affects the efficiency of precipitation and it has been pointed out that for this reason a 21-in. rainfall on the Texas plains is no better for crops than 15-in. in Montana or Dakota. The character of the soil also affects the productivity of the lands. On the whole, crop raising in the Great Plains region compares unfavorably with the districts east and west, which have better conditions as to soil moisture.

On the other hand, studies and experience show beyond question that wherever supplemental water can be applied intelligently and at reasonable cost, the crops are equal to those produced in other parts of the country. I could give numerous illustrations of profits derived from irrigation throughout the Great Plains. It is simply a question of cost, and it is safe to say that the limit of agricultural land susceptible of irrigation from streams, reservoirs and underground supplies is far from having been reached. A large proportion of the area can never be profitably irrigated, but this very fact will in time make the other lands all the more valuable, and I am certain that irrigation will be practiced profitably in numerous localities where it is as yet hardly deemed possible.

* * *

Methods of Flood Control

By L. K. Sherman
Consulting Engineer, Chicago

FLOOD heights may be reduced by temporarily withholding in reservoirs a portion of the water that would otherwise pass downstream at the peak of the flood. Storage reservoirs are filled with the excess flood water, which is all retained until after the passage of the flood crest. Retarding reservoirs withhold a portion of the stream inflow while a reduced outflow continues. The word "storage" is frequently used by engineers to define the volume (usually in acre-feet) included between two stages or surfaces in a designated reach of the river. But "storage" is a misnomer that may lead to confusion, for the above defined water is not only moving downstream, but it is moving faster with every increase in stage. The apparent storage for any foot increase of stage is the difference between the inflow and outflow noted during the stage rise. However, a long reach of river does have a material effect in flattening out the peaks of flood waves from upstream tributaries, where such peaks are not supported by continuous flow for a period equal to their time of travel down the reach.

If a tortuous stream is straightened by cutoffs so that distance is reduced one-half, then the slope is doubled, the velocity is increased and the flood stage is reduced. The maximum high-water stage below the improvement will not, in general, be increased. In a study of such an improvement on the Okaw River, in Illinois, we found that the new channel would lower the flood height about 6 ft. and prevent overflow of bottom lands. The peak stage of water below the improvement would not be increased, but the peak would come a day earlier and the rate of rise preceding the flood would be faster. This case brings out the point that faster running water does not necessarily mean more water.

Besides channel clearing and enlargement, the removal of brush and timber within the river floodway will materially increase the discharge capacity. There are frequently topographical conditions where the flood plane can be lowered by a parallel or side diversion channel to carry excess flood water. Protection by levees is the most direct and the commonest method, but in many instances levees were built without considering the other stream regulating agencies above mentioned. Levees raise the flood stages.

Flood protection measures are largely a question of insurance. How frequent are the ordinary and maximum flood heights? How much damage results or how much land utility is prevented? Will the construction costs exceed the benefits? To answer these questions the engineer need be a prophet. But the records of stream gaging stations and investigations and long-time records in flood frequency have been developed to the point where reliable prophecy can be made. Of course, the flood stage which has an expectancy of once in 100 years is not 100 years away. It may come tomorrow. This point is not to be forgotten when we figure the cost and value of flood prevention.

* * *

The Canadian River Interstate Problem

By A. S. Stinnett
Texas Commissioner for Canadian River

THE South Canadian River rises within the southern boundary of Colorado, passes 400 miles across New Mexico, 200 miles across the panhandle of Texas and 400 miles in Oklahoma before entering the Arkansas River near the boundary of Oklahoma and Arkansas. Perceiving the damages resulting from periodic floods, Oklahoma enacted the first legislation toward flood control in 1924. For twenty years previous, Texas and New Mexico had been observing the performance of the Canadian River and wondering why the flood waters were not controlled through a system of impounding dams and the water applied to irrigation, power and industry. Finally the three states united their forces.

As the new Oklahoma law had founded a commission, the governors of Texas and New Mexico also named commissioners and the first interstate conference took place at Amarillo, Tex., in 1925. An organization of the commissioners followed and a tentative treaty was formulated. Both New Mexico and Texas did engineering work toward ascertaining the feasibility of the project. Interstate conferences followed at Amarillo and Oklahoma City in 1925 and 1926. Meanwhile the federal Congress had been consulted with the object of co-ordination between Congress and the three states through a tri-state treaty or compact framed by the commissions and ratified by the legislatures. At the conference in Amarillo, November, 1926, the commissioners devised and signed the compact. The governors of Oklahoma and New Mexico submitted the compact to their respective legislative bodies in January. Each passed an act of ratification, which received the governor's approval.

Oklahoma being the pivotal state, the Texas commissioner held back until Oklahoma had definitely acted, but it was then too late for the regular session of the Texas legislature. However, assurances have been received from the governor that he will submit the compact to the extra session of the legislature in May, 1927. Quick passage of a ratification act is confidently anticipated. It is also believed that the appropriations made at that session will provide for an intensive survey of the Texas portion of the river by the chief engineer of the State Board of Water Engineers of Texas.

New Mexico has made appropriation for continuance of the engineering work on the river within that state. Oklahoma has been engaged upon an engineering study, which embraced the South Canadian River, for several years and has complete data and reports. New Mexico and Texas should have their engineering work sufficiently complete within a few months to enable the three states to seek appropriate legislation by Congress, to be followed by final ratification by the state legislatures.

Canadian Provincial Road Expenditures

During 1926 $45,563,000 were spent on construction and maintenance of Canadian provincial highways, according to a report from the Highways Department of the federal government. Of this sum $29,585,000 were spent on construction and $15,978,000 on maintenance. Roads involved in this aggregate expenditure totaled 46,824 miles. Older Ontario led with a total outlay of $21,170,000, of which $14,020,000 represented construction and $7,150,000 maintenance, the mileage involved being 15,861. Northern Ontario spent $4,000,000, $2,400,000 for construction and the remainder for maintenance, the total mileage of roads being 2,552.

Downtown Location Recommended for San Francisco Bay Bridge

Board of Engineers Reports on Three Best Locations—Two 1,250-Ft. Spans Required—Deep Foundations

LAST YEAR application was made to the San Francisco Board of Supervisors by various groups of promoters for a franchise to build a toll bridge across the bay from San Francisco to the East Bay communities of Alameda, Oakland and Berkeley. After receiving a number of these applications, the supervisors held protracted hearings at which all the applicants separately presented their plans, cost estimates and financial proposals. Some 18 or 19 projects were thus submitted, as summarized in *Engineering News-Record*, Oct. 28, 1926, p. 720 and Nov. 4, 1926, p. 757. Subsequently the supervisors decided to retain three engineers not connected with any of the projects as a board to decide upon the best location for a trans-bay bridge and its general characteristics, such as clearance height, spans, loadings, terminal facilities, and financial problems involved in construction. Robert Ridgway, New York; Prof. Arthur N. Talbot, Urbana, Ill.; and John D. Galloway, San Francisco (*Engineering News-Record*, March 31, p. 541) were named to form this board.

The report of the board of engineers was rendered on May 5. As outlined in our last issue (p. 788), it recommends as the best site a location differing from any of those proposed by the franchise applicants, namely a crossing from Rincon Hill, near the San Francisco terminal of the Southern Pacific Ry., to Alameda Mole, a short distance south of the Oakland Estuary. Two other locations are proposed as second and third choices, the second lying a short distance south, the third a mile and a half north, crossing from Telegraph Hill to Goat Island and thence on to Oakland. All three locations are north of Hunters Point, which has been fixed by the War Department as the northerly limit of permissible bridge construction in San Francisco Bay. The board of engineers suggests that the city at once apply to the War Department for authority to build a bridge at the preferred location.

From the text of the report, the following statement of the facts and views of the board with respect to location and related problems is abstracted.

Preferred Location—The Rincon Hill-Alameda Mole location was selected as best for the following reasons:

It affords the most available direct route between the business centers; all the existing interurban lines may reach the bridge; the Alameda and Oakland termini reach the principal traffic highways; the San Francisco terminus is accessible from the entire street system of the city and is close to the business and shopping districts; interurban and main line passenger stations may be provided; there is storage space for interurban cars; the land values on Rincon Hill are not high; no obstacles are placed across Oakland Harbor; there is no interference with the projected Alameda harbor; the largest existing wharves on the San Francisco water front lie seaward of the bridge; the clearances are all that commercial interests require; there is no interference with the proposed Alameda Naval Base and only a minor interference with the naval anchorage grounds; the existing ferry lanes are left free; Rincon Hill is an excellent point on which to terminate the bridge; any future rapid-transit system may easily be connected to the interurban system; and the present street-car systems can readily be diverted to the terminals.

This location, marked by a heavy line in the accompanying map, is planned to terminate on the San Francisco side in an elevated railway loop extending along Fremont, Tehama, Seventh and Bryant Sts.; nearby there is to be a terminal for special interurban trains which would carry passengers from the terminals of the main-line railway on the east side of the bay to San Francisco. A wide plaza for automobiles is also contemplated.

Neither main-line trains nor city street cars are to be carried on the bridge, but full provision is made for interurban railway trains. The structure is to have two decks. The upper deck would furnish a 42-ft. highway for automobiles, while the lower deck would carry three interurban railway tracks.

Over the main part of the bay the bridge is to be at a high level, giving a vertical clearance of 150 ft. above mean high water. Tentatively the board decided on two 1,250-ft. spans next the San Francisco water front, followed to the east by a series of spans 500 to 750 ft. long, to a total distance of 12,000 ft. from the San Francisco shore; the approaches at both ends would be short deck spans, the east approach finally passing by concrete-pile trestle to Alameda Mole. Thence the railway and highway lines would extend east to Alameda on embankment and also turn north to Oakland by two tunnels under the Oakland estuary and elevated viaducts over the Southern Pacific Ry. yards, reaching a connection with the interurban lines in Oakland and connecting with the Oakland street system at Peralta St.

Potrero Point Location—The location ranked second extends from Potrero Point, at 22nd St., to a point south of the inner end of Alameda Mole and west of Pacific Ave., Alameda. The bridge would have the same general structural arrangement as a bridge on the first location, and like it would terminate in a loop on the San Francisco side and in tunnel extensions to Oakland at the east end.

On this location the high-level bridge would be 800 ft. longer and the approaches about 5,000 ft. longer than on the first location. A much longer length of elevated railway in San Francisco would be required. The location lies at an angle with the bay currents; the San Francisco street system is less favorable, and travel distances are increased nearly 3 miles over the first location. Further, the bridge would pass across the Alameda Naval Base site and over the naval anchorage.

Goat Island Location—A site from Telegraph Hill to Goat Island and thence by the Key Route Mole to San Pablo Ave., Oakland, is ranked third. The engineers believe that at this site spans not less than 1,500 ft. long, with vertical underclearance of 220 ft., should be provided between San Francisco and Goat Island.

While a bridge on this location would not interfere with the Naval Base, the fleet anchorage, or the proposed Alameda harbor development, and would not obstruct the entrances to Oakland harbor, and in point of travel distance is about equal to location 1, the board finds it to have many unfavorable features. At the east end, interurban and highway traffic from Alameda cannot reach the bridge except by tunnels under the estuary. At the west end, the terminal would be in a region of narrow streets with inadequate connections to the main city system and lacking a site for an interurban line terminus or for storage of trains. Practically all automobile traffic on the East Bay side

must reach the bridge by one main highway. The bridge is seaward of all the principal harbor development of San Francisco and Oakland, and would permanently limit the height of shipping. Borings made on this site indicate unprecedented depths for bridge piers.

Foundation Conditions—No subsurface exploration data were available except from two borings made between Goat Island and Telegraph Hill. These reached rock at depths of 208 ft. and 254 ft. respectively. The board assumes that foundation conditions "must be expected to present great difficulties and extremely expensive construction," and therefore does not presume to make definite statements on pier locations and span lengths. A comprehensive investigation of subsoil conditions along the proposed location is recommended as a preliminary to the design of a bridge. The board says that "at best the building of the piers will be a difficult and hazardous undertaking."

As a precaution against the effect of collision of vessels, it is recommended that the piers for the bridge should rise at least 30 ft. above water and be so arranged that a ship cannot strike or injure the steelwork and would not itself be injured by the collision.

Bridge Type—The physical conditions are held by the board to prohibit use of a suspension design, and accordingly cantilever spans are proposed for the long-span part of the bridge, simple trusses to be used in the shorter spans.

Roadway grades of 6 per cent maximum for highway traffic and 4 per cent maximum for interurban railway traffic are recommended.

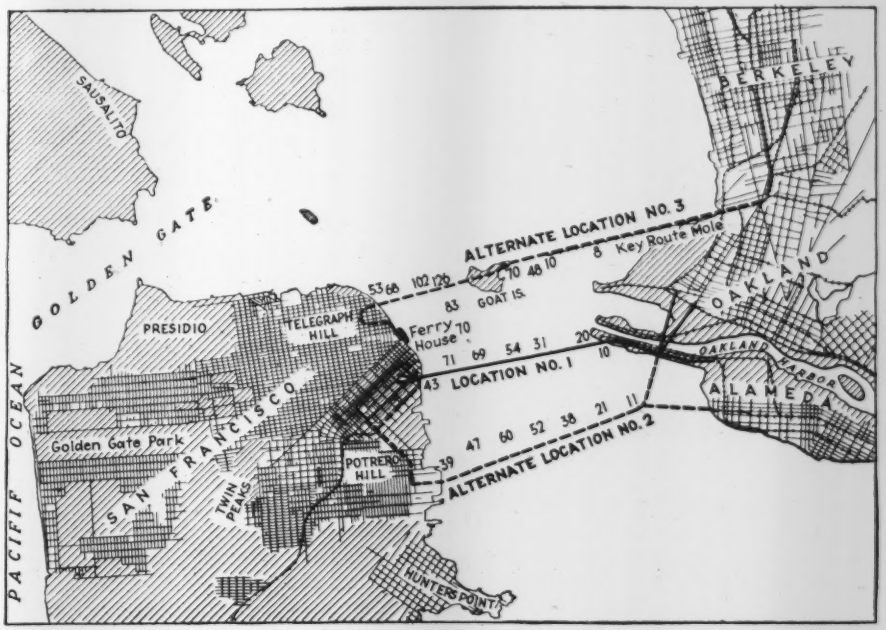
A movable span of at least 200-ft. clear opening flanked by a 250-ft. span on each side is to be provided in the low-level eastern portion of the bridge.

Traffic Demands—The board decided against providing for main-line railway traffic on the bridge on several grounds: the large increase in cost of structure, the flatter approach grades required and the consequent increase in length of approaches, the lack of space for terminal stations and yards, and the size and cost of such yards if space were available. The passenger traffic of the railroads would be only 4 per cent of the total and could not bear the burden of the increased cost, while, on the other hand, this passenger traffic is easily taken care of by transfer to special interurban trains on the East Bay side. For similar reasons, no provision for main-line railroad freight is made. It is recommended that if railroad traffic is to be carried across the bay at some future time consideration should be given to tunnels.

Accordingly, interurban railway and automobile highway traffic are the two services to be considered, and of these the former is at present the more important. In 1926 more than 43,000,000 passengers were carried across the bay on the ferry routes, in addition to about 1,500,000 main-line railroad passengers. Automobile and truck traffic across the ferry for the year was about 2,600,000. Based on these figures, the bridge traffic estimates for 1940 and 1950, assuming the bridge opened for traffic in 1935, are:

	1940	1950
Interurban passengers (trains and vehicles)	58,800,000	68,610,000
Main line train passengers	2,300,000	3,000,000
Total	61,100,000	71,610,000
Automobiles	6,958,300	8,745,000

This is described as a conservative estimate, which may be exceeded. The maximum interurban traffic in 1940, it is estimated, can be handled on a two-track line with the service of 34 ten-car trains per hour. A three-track line is estimated to be capable of handling the traffic to a period far beyond 1950.



SAN FRANCISCO BAY BRIDGE LOCATIONS RECOMMENDED BY ENGINEER BOARD

Automobile traffic, assuming the peak hour to represent 15 per cent of the one-day traffic in one direction, can be taken care of by a four-lane roadway up to a point 50 to 70 per cent beyond the 1950 traffic estimate. The board says, however, that "The subject of automobile traffic is not susceptible of as accurate analysis or forecast as interurban traffic."

Financial Features—The board makes no estimate of the cost, stating that in the absence of vitally necessary information regarding foundations it is not possible to make an estimate of cost of the bridge that would be of value. It says, however, that not only are the engineering problems "in many respects almost without precedent," but the financial features of the project are also of greatest magnitude.

It suggests the following plan of procedure for the city authorities: (1) Obtain permission from the War Department to build the bridge at location 1; (2) explore the site by borings in order to determine foundation conditions; (3) prepare a proper design, make cost estimates, and carry out an economic study of the entire project.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Water Power Engineering

REVIEWED BY BYRON E. WHITE
General Engineer, Utica Gas & Electric Co., Utica, N. Y.

WATER POWER ENGINEERING—By H. K. Barrows, S. B., M.Am.Soc. C. E., M. Am. Inst. C. E., Professor of Hydraulic Engineering, Massachusetts Institute of Technology, Consulting Hydraulic Engineer. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 734; 306 halftones and line cuts. $6.

Progress in the field of water power or hydro-electric engineering is and has been so rapid that a publication fully treating the subject can hardly be off the press before it is to some extent, at least, out of date in the treatment of certain details. Professor Barrows has covered the entire field very well, considering the space limitations which are necessarily imposed. Numerous examples of up-to-date practice are to be found throughout the volume. As stated in the Preface, the book is primarily intended as a textbook for students and the author expresses the hope that it will be found of value to the practising engineer. A perusal of the work shows that the latter hope has been realized for there are several features which are especially well treated and will be of particular use to those who are not specialists but have to cope with some of the special problems connected with water power engineering. The specialist will also find much of interest to him between its covers.

The chapters on hydrology, the study of stream flow data and water power estimates, hydraulic turbines, speed and pressure regulation, electrical equipment and transmission lines are particularly good, treating the subjects very clearly and fully, considering the space devoted to them. The chapter on cost and value of water power will also be found interesting and useful. Other chapters contain much useful information in regard to dams, waterways, power houses and hydraulic equipment. Much of this information will be found useful in the making or checking of designs.

There are several tables scattered throughout the book showing dimensions and other data for numerous hydro-electric installations which are useful for reference and comparative purposes, and the chapter containing general information concerning water power development in this country and the other countries of the world will be of value to all who are interested in the extent, progress and possibilities of water power development.

The book is a real contribution to the literature on the subject and is worthy of a place in the library of any engineer whose practice deals with the engineering of hydro-electric plants.

American Ships in the Great War

THE BRIDGE TO FRANCE—By Edward N. Hurley, Wartime Chairman of the United States Shipping Board, Author of "The New Merchant Marine," "The Awakening of Business," "Banking and Credits in Argentine, Brazil, Chile and Peru," etc. Philadelphia, Pa., and London, England: J. B. Lippincott Co. Cloth; 6x9 in.; pp. 338, 25 halftones and drawings. $5.

As time goes on the records of the great war are being accumulated. Impressions hastily gathered during the conflict are being replaced by authentic histories by those who were making history. To this collection must now be added Mr. Hurley's contribution. He was intimately connected with the great shipbuilding adventure as chairman during the war of the United States Shipping Board. This record, which he now presents, is a valuable contribution because it sets down in detail the development of a great enterprise whose growth was only obscurely revealed. The wood ship controversy, the Goethals-Denman imbroglio, the concrete ships, the fabricatel ships, Hog Island—all these so familiar things are recorded interestingly but accurately. So many engineers were connected with the building of our "bridge to France" that this book should have a particular appeal to the engineering profession.

New and Unique Annual

STANDARDS YEAR BOOK, 1927—Compiled by National Bureau of Standards. Cloth; 6x9 in.; pp. 392 + plates containing 39 diagrams and halftones. $1 from Superintendent of Documents, Washington, D. C.

This new and unique publication by the Bureau of Standards is not, as one might expect, a summary of what the bureau has accomplished during the past year or throughout its quarter century of existence, but is a general compilation of data and references on the standardization movement. It describes separately the various international, national and federal standardization agencies, municipal and state agencies, and the various standards committees and societies engaged in standardization. More or less incidentally, it also reviews some activities and accomplishments of the Bureau of Standards, devoting some 120 pp. to this purpose.

An impressive view of standardization may be obtained by the reader who has the patience to dig through the rather wordy compilation. The items of real information are diluted by a large amount of water, such as the statement that a **new** marine corps automobile enamel has been adopted **as** the standard paint for marine corps motor vehicles, and that its shade approximates the color of the winter service uniform; that the Post Office Department by the substitution of newsprint paper for manila paper used for facing slips accomplished a saving of $11,776.20; and that the Bureau of Efficiency has prescribed a uniform procedure for rating the efficiency of practically all employees in the classified departmental service regardless of the type of work on which they might be engaged. The term "standards" moreover is used in a very catholic sense. The Children's Bureau, for instance, is aiming to ascertain and to popularize just standards for the life and development of the children of America. The Bureau of Fisheries is attempting to accomplish standardization in the collection of statistical data in the various states. The Agricultural Department during 1926 promulgated definitions and standards for "sauerkraut, almond paste and kernel pastes, wine vinegar, grape vinegar, and malt vinegar, milk and its products, glucose, Dutch process chocolate and Dutch process cocoa, fruit and fruit products, flour, meat, and the principal meat products." The Department of Com-

merce is attempting to draft a uniform state mechanics lien act, which presumably also comes under the head of standards, and the same department drafted a "standard city zoning enabling act." However, apart from these special or peculiar items, the book presents a picture of an amazingly extensive, varied and important range of activities.

Perhaps the most impressive part of the book is the descriptive list of societies and trade associations (chiefly the latter) carrying on standardizing or related investigational work. Eight pages near the close of the book are occupied by this catalog. The tremendous growth of the trade association movement since the war, and the part it is endeavoring to play in improvement of quality, simplification of production, and clarification of questions between producer and user, can be appreciated better from this chapter than from any other recent publication.

It is planned to publish this "Standards Year Book" annually, the present being the first issue.

French Work on Water Power Engineering

REVIEWED BY A. J. LUCHINGER
Civil Engineer, Zurich, Switzerland

MECHANISME DE L'EAU ET PRINCIPES GÉNÉRAUX POUR L'ÉSTABLISSEMENT D'USINES HYDRO-ÉLECTRIQUES—Par Ingénieur René Koechlin. Paris: Librairie Polytechnique Ch. Béranger. 3 volumes. Paper; 6 x 10 in.; pp. 1,105; 436 illustrations. 40 Swiss francs.

The author of these three volumes on Hydro-mechanics and Principles of Water Power Engineering is an eminent European engineer and scientist, under whose direction numerous large hydro-electric developments in almost all parts of Europe have been built. The partly new theories and interesting theoretical deductions presented, as well as the great amount of practical knowledge, give his book a value which certainly ought to go far beyond his own country.

The first volume treats in part the laws of hydrology and general hydro-mechanics, of which the chapter on the theory of flow in open channels is particularly interesting. The author derives in a very pleasing manner the formula $V_B = K_I\sqrt{rs}$, in which V_B = effective bottom-velocity (instead of the mean velocity as usual); r = hydraulic radius; s = slope; $K_I = \sqrt{2g/f_I}$, where f_I = total height of bottom irregularities per unit of length or height of water of which the velocity is used up by friction per unit of length.

He then develops a new formula for the relation between the bottom velocity and the mean velocity in a wide channel: $V_m = V_B + \frac{1}{3}\frac{ws}{\mu}d^2$, where V_m = mean velocity; w = unit weight of water; d = depth of channel; μ = coefficient of cohesion. Combining the two equations, he arrives at the well-known formula, $V_m = K\sqrt{rs}$, where $K = K_I + \frac{1}{3}w\frac{\sqrt{s}}{\mu}r^{3/2}$ (for wide channels $d = r$). Because most of the existing measurements are based on the mean velocity, the determination of the coefficients K_1 and f_1 is done by the following method: For $r = o$, $K = K_I$ and therefore $K_I = V_m/\sqrt{rs}$, and K_I determined $f_I = 2g/K_I^2$.

The author has had very good results with this new formula with values of r from 0 to 3 (metric) and gives a similar formula also for pipes and tunnels.

Further interesting chapters in the first part of Vol. I, with many new viewpoints, are his studies on the formation of the river profile, silt and gravel transportation, ice formation in rivers and a very valuable discussion of the mechanics of glaciers. The second part of Vol. I takes up the hydraulics of pipe lines, canals with varying cross-section, flow over weirs, water hammer, backwater curves, where the author develops a very simple approximation, and hydraulic turbines.

The second and third volumes contain one of the most thoroughly written presentations yet made of the theoretical and practical problems arising in the economic, hydraulic and structural field of water power engineering. It is written from the standpoint of a true engineer, that is, the standpoint of always having the principles and the end result in mind, never giving a formula without its derivation, using the formula as a tool and proceeding to the desired result without dwelling too much on details. The discussion stimulates much thought; it is for the engineering mind, which never loses contact with the principles of nature.

Vol. II deals with fixed and movable weirs, including an extended study of erosion below spillways and of the hydraulic jump. About 20 drawings showing recent types of gate installations are reproduced. There is a long well illustrated chapter on earth dams, then 110 pp., with 120 illustrations, on gravity, arch, and reinforced-concrete dams, including the important theory of inclined stresses. The next chapter deals with intake structures and canals, with special reference to canals having earth dikes and their permeability. Using the formula $V^m = A\ s$ for the flow of water through a dike, where V = velocity in m.m. per sec. and s = loss of head per unity of length, the author gives the coefficients m and A for various soil conditions as determined in a series of interesting tests. For gravel and sand, well mixed, m equals 1; for gravel alone, according to size, m equals 1.1 to 1.7; the factor A varies from 3 for sand with very fine gravel to 2,500 for gravel of 8-60 m.m., without sand. There follows a very nice graphical method to determine the lines of infiltration through earth dikes of various cross-sections.

The third volume gives valuable solutions for the various problems on pipe lines, surge tanks and pressure tunnels. Having in mind the many recent defects in high pressure tunnels, the theory and derivations of simple formulas and the practical examples included make this chapter especially valuable. The author shows the importance of the right determination of the modulus of elasticity of rock and offers a series of instructive figures, which give deformations and stresses for a rock tunnel of 3 m. diameter with different internal pressures and accordingly different linings (concrete, reinforced-concrete and steel shell on concrete), all figured for a modulus of elasticity that varies as ten to one between very hard rock and very bad rock.

The chapters on power houses, spillways, ship locks and fish ladders are all very well written and illustrated. Of special interest are the economic studies on the location of the power site, the size of the installation, cost comparisons of steam and hydro-electric stations and their combination. The last chapter deals with the important problems of water storage and accumulation by pumping. This newest form of power accumulation, of which there are already about eight actual installations in Europe (the newest one being the Waeggital development described in *Engineering News-Record*, Sept. 9, 1926, p. 410) will certainly interest every hydraulic engineer.

Foundation Construction and Exploration

DER GRUNDBAU—Von O. Franzius, Professor an der Technischen Hochschule zu Hannover, Unter Benutzung einer Bearbeitung von O. Richter, Regierungsbaumeister a. D. Frankfurt a. M. Berlin: Julius Springer. Cloth; 7x10 in.; pp. 360; 389 figures in the text. 28.5 reichsmarks in Germany.

BELASTUNG DES BAUGRUNDES: Sammlung der in der "Sparwirtschaft Zeitschrift für wirtschaftlichen Betrieb" ershienen Veroffentlichungen. Wien (Austria, III Lothingerstrasse 12): Osterreichischer Normenausschuss für Industrie und Gewerbe Geschaftsstelle. Paper; 6x9 in.; pp. 78; 1 halftone, 13 line drawings, 1 chart.

MODERNE GRUNDBAUTECHNIK: I TEIL, DIE KURZSCHACHTGRÜNDUNGEN MIT DER GRUNDKÖRPERMASCHINE—Von Ingenieur I. Zeissl, Direktor der Stern-Gesellschaft für Moderne Grundbautechnik, M. B. H. II Teil, Theorie der Tiefschachtgründungen mit der Grundkörpmaschine—Von Zivil-Ing. Ottokar Stern, Geschaftsführer der Stern-Gesellschaft für Moderne Grundbautechnik, M. B. H. Both parts, paper; 5x8 in.; I Teil, pp. 64 with 29 halftones and line cuts; II Teil, pp. 56; 11 halftones and line cuts and one plate. Each part, 2.7 reichsmarks, in Germany.

"Der Grundbau," by O. Franzius, represents a general text and treatise on foundation construction. After a description of borings, piles, and sheetings, the author takes up successively simple foundations in the dry and in water; cylinder, pile and compressed air foundations. A chapter on groundwater lowering and a few paragraphs on the use of the freezing process are of special interest. The work is naturally adapted more to European than to American conditions of practice, but it can prove of much value to the American student of foundation work also.

A proposed Austrian standard method for determining the load-carrying capacity of soil is described in "Belastung des Baugrundes." It consists of the use of a 3-in. rod or stake with conical steel point 8 in. long, which is driven into the ground the full depth of its conical point and is then progressively loaded at the rate of 1 lb. in 5 min. for plastic soil and 2 lb. in 5 min. for non-plastic soil until the penetration approximates $\frac{1}{4}$ in. The load is then left in place for 12 to 24 hr. while the soil around the stake is kept covered with water; the total penetration must not exceed a specified amount, about $\frac{1}{4}$ to $\frac{3}{4}$ in., depending on the kind of structure to be built. Half the load producing this penetration is to be taken as permissible foundation pressure. Several discussions and remarks on the proposed method are included in the pamphlet. Two associated pamphlets, respectively by I. Zeissl and O. Stern, appear to have the character of trade publications, describing a concrete pile system of the Compressol type, which apparently was developed in conjunction with the cone soil testing method.

The publications noted are available in the German language only and are not published in America.

Searching Out Old Waterways

OLD TOWPATHS: The Story of the American Canal Era—By Alvin F. Harlow. New York and London: D. Appleton & Co. Cloth; 6x9 in.; pp. 403; numerous illustrations. $5.

Old canals have a peculiar fascination. There is something of mystery about them and a sense of peace entirely foreign to our modern methods of transportation. They seem to be the only surviving record of those days when the colonies along the Atlantic seaboard began their great expansion westward. To them the country owes much of its early development. A little more than a century ago when steam railroads were unknown, and even as late as 1830, canals were considered the best method of long-distance transportation and many were built only to be superseded by railroads in a few years. With the history of those days, of the promotion, financing and building of all the well-known canals and many of those which can only be located with difficulty now, this book deals. Naturally much space is devoted to the important canals like the Erie, Delaware & Hudson, and the Chesapeake & Delaware, but the reasons which led to the building of lesser canals may be found too. The almost forgotten canals of New England and Indiana and the many canals built in Pennsylvania, Maryland, Ohio and the Carolinas are all included: a total of 4,400 miles of waterways. The book is no dry record. It is an interesting historical narrative written primarily for general reading but of special interest to engineers who will find in it an account of many works of engineering of which the profession may well be proud.

Autobiography of Dr. Victor C. Vaughan

A DOCTOR'S MEMORIES—By Victor C. Vaughan. Indianapolis: The Bobbs-Merrill Co. Cloth; 6x9 in.; pp. 464. Illustrated. $5.

The services of Dr. Vaughan as a member of the Commission that studied and reported on typhoid fever in army camps during and after the Spanish-American war and much of his expert work in sanitation and allied matters before and since that period have made his name familiar and honored by many engineers and sanitarians. Among the physicians of the country, he is even better known as Dean of the University of Michigan Medical School for three decades and as a medical expert. These Memories review his early life on an old Missouri farm, his education, his connection with the Medical School of the University of Michigan and his experiences of the practice of medicine and as medical expert. There are separate chapters on his services during the Spanish-American war, on the Typhoid Commission, on the National Research Council, in the World War and as a member of medical and scientific societies.

Two very interesting chapters deal with the author's intellectual and social life and with his reaction to old age. The entire book is unusually readable, even for a first-class autobiography. It abounds with stimulating suggestions.

High Pressure Selling Condemned

THE DISTRIBUTION AGE: A Study of the Economy of Modern Distribution—By Ralph Borsodi, Author of "National Advertising," "The New Accounting," etc.; With an Introduction by Lew Hahn, Managing Director of the National Retail Dry Goods Association. New York and London: D. Appleton & Co. Cloth; 6x8 in.; pp. 321; 11 plates (or charts). $3.

How to stop the increasing cost of getting commodities from the producer to the consumer, to the advantage of both, is the problem considered in this book. The author shows that in relation to what the consumer pays the producer has, in the last few decades, materially lessened the cost of commodities up to the point where they leave his hand but that distribution costs have been rising steadily. This condition he attributes to (1) efficiency in production, which is commendable and (2) overproduction and high-pressure selling methods, which he condemns. In a few years more these high-pressure selling methods, the author asserts, will swell still further the already huge army of distributors, making it still more oversized as compared with the producers.

The evils which the author singles out for chief condemnation are selling by brand, through national advertising and other high-pressure means, rather than by quality specification. He claims that this reduces both wholesalers and retailers to automatons, whereas, he urges, they should be purchasing agents for consumers. One of the points pressed by the author is that the purchasing power of consumers is limited—by the available funds of the vast majority and by the physical limitations of the rich. High-pressure salesmanship does not increase consuming power, but merely shifts it from one brand to another. The resulting increased distribution cost falls on the consumer and reduces, for the masses, their purchasing power.

The book deserves wide reading and thoughtful consideration, both by producers and consumers.

Publications Received

SIXTY-FIVE springs in the United States having an average discharge of 100 sec.-ft. or more are described in Water-Supply Paper No. 557, Large Springs in the United States, by Oscar Edward Meinzer. Halftones and diagrams add to the interest and value of the paper which extends to 94 pp. (30c. from Superintendent of Documents, Washington, D. C.)

FOR THE FIRST TIME, so far as we are aware, a short monograph has been published on Methods of Exploring and Repairing Leakage at Artesian Wells. It is in the form of a 32-p. illustrated reprint from contributions to the hydrology of the United States, 1927, and consists of papers by John McCombs and Albert G. Fiedler, prefaced by some notes written by Oscar E. Meinzer. (15c. from Superintendent of Documents, Washington, D. C.)

THE WATER POWERS OF MANITOBA are listed in Water Resources Paper 56, Dominion Water Power and Reclamation Service, Canada (Ottawa). The report contains a brief description of main physical features, river systems and power resources of the Province of Manitoba, existing hydraulic installations and undeveloped power sites (listing 3,000,000 hp., undeveloped, continuous under ordinary flow) on the rivers of Manitoba.

SAFETY CODES for the Prevention of Dust Explosions, sponsored by the National Fire Protection Association and the United States Department of Agriculture have been published as Bulletin 443 of the U. S. Bureau of Labor Statistics. (10c. from Superintendent of Documents, Washington, D. C.) The various codes included have been tentatively approved by the American Engineering Standards Committee. They deal with factories, flour and seed mills, grain elevators, sugar, cocoa and pulverized coal.

A COMPREHENSIVE REPORT on the Passaic Valley trunk sewer and sewage-works, summarizing the history of the district, listing the communities under contract with the commissioners, describing the trunk sewer system, the pumping stations and the outlet tunnel to New York Bay, and reviewing the operations of these elements since they were put in use in 1924, has been issued by the Passaic Valley Sewerage Commissioner (24 Branford Place, Newark, N. J.). Joseph H. Quigg is secretary and J. Ralph Van Duyne is chief engineer of the commission.

SIX YEARS' Investigations of Chemical Reactions Involved in Water Purification (1920-25) are summarized in Bulletin 22, Illinois State Water Survey (Urbana, Ill.). There is an introduction by A. M. Buswell, chief of the bureau. Mr. Buswell is also joint author of the four detailed parts of the report—with R. E. Greenfield, on The Use of the Hydrogen Electrode in Investigations of Chemical Reactions, with G. P. Edwards on the Relation of Hydrogen-Ion Concentration to the Properties of Alum, with W. U. Gallaher on Precipitation of Calcium, Magnesium and Aluminum, and with L. H. McRoberts, on Precipitation of Alumina in the Acid Range of Hydrogen-Ion Concentration. There is a bibliography.

THE PRICE of Zeissl's Moderne Grundbantechnik, noted in these columns on Jan. 20, 1927, p. 125, should have been given as 2.7 instead of 7.2 reichsmarks. The book is published by Wilhelm Ernst & Sohn, Berlin, Germany.

SAFEGUARDING WORKMEN AT OIL DERRICKS is the title of Bulletin 272 just issued by the U. S. Department of Commerce, Bureau of Mines. It is written by H. C. Miller. The bulletin gives much valuable and needed information and is well illustrated. Derrick design is considered from a safety viewpoint including in addition the use of platforms, ladders, safety belts, safe lighting practice and guard rails around the machinery on the derrick floor. (40c. from Superintendent of Documents, Washington, D. C.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

BENJAMIN GARVER LAMME, ELECTRICAL ENGINEER: An Autobiography. New York and London: G. P. Putnam's Sons. Cloth; 6x9 in.; pp. 271; many halftones. $3.

BERÄKNING AV UTJAMNINGSBASSÄNGER SÄRSKILT VID LÄGTRYCKSANLÄGGNINGAR—By Frederik Jonson. [Tekniska meddelanden Från Kungl. Vattenfallsstyrelsen, Ser. B. N:R 11.] Stockholm: Centraltryckeriet. Paper; 6x9 in.; pp. 79; 21 line cuts. Kr. 2.5.

BITUMINOUS SANDS OF NORTHERN ALBERTA: OCCURRENCE AND ECONOMIC POSSIBILITIES. Report on Investigations to the End of 1924 (with Topographic Maps in separate folder)—By S. C. Ells. Ottawa, Ont.: Canada Department of Mines. Paper; 7x10 in.; pp. 244; illustrated.

THE BUILDING ESTIMATOR'S REFERENCE BOOK: A Practical and Thoroughly Reliable Reference Book for Contractors and Estimators Engaged in Estimating the Cost of and Constructing All Classes of Modern Buildings; with separate book, THE VEST POCKET ESTIMATOR—By Frank R. Walker, Affil. Am.Soc.C.E., Author of "Practical Accounting and Cost Keeping for Contractors." Sixth Edition. Chicago: Frank R. Walker Co. The Reference Book: leather; 5x7 in.; pp. 1,681 including index; illustrated. The Vest Pocket Estimator: 3x5 in.; pp. 188; illustrated. $10 including Vest Pocket Estimator (latter not sold separately.)
Revised, and data on new materials and methods added. Vest Pocket Estimator doubled in size.

CARAVANS OF COMMERCE—By Isaac Marcosson. New York and London: Harper & Brothers. Cloth; 5x8 in.; pp. 331; 6 halftones. $3.

CONSTRUCTION AND OPERATION OF THE WIRE DRAG AND SWEEP—By Lieut. Commander J. H. Hawley, U. S. Coast and Geodetic Survey. [Serial No. 317, Special Publication 118, Department of Commerce, U. S. Coast and Geodetic Survey, E. Lester Jones, Director; Hydrography section.] Washington, D. C.: Government Printing Office. Paper; 6x9 in.; pp. 64; 17 line cuts and halftones. 10c. from Superintendent of Documents, Washington, D. C.

THE EMPIRE MUNICIPAL DIRECTORY AND YEAR BOOK FOR 1927-28. London: Municipal Engineering and Sanitary Record Breams Buildings, E. C. 4. Cloth; 7x10 in.; pp. 318. 11 shillings.
Besides giving populations and the principal administrative officers of England, Wales, Scotland, Canada and various other parts of the British Empire, the current issue includes the populations and a few officials of nearly 60 of thte "Principal Cities of the World." In addition to the directory, the volume contains text on the status of roads, concrete, water supply, housing and other topics, list of books, societies, etc. A Trades Directory is included.

ERDSTATISCHE BERECHNUNGEN MIT REIBUNG UND KOHÄSION (ADHÄSION) UND UNTER ANNAHME KREISZYLINDRISCHER GLEITFLÄCHEN—By W. Fellenius, Professor an der Königl. Technischen Hochschule zu Stockholm, Berlin: Wilhelm Ernst & Sohn. Paper; 7x10 in.; pp. 40; 27 line cuts. 4.20 reichsmarks in Germany.

FINANCIAL STATISTICS OF CITIES HAVING A POPULATION OF OVER 30,000: 1925. Bureau of the Census, W. M. Steuart, Director. Buckram; 6x9 in.; pp. 503; $1.25 from Superintendent of Public Documents, Washington, D. C.
Figures and text along the lines followed in earlier reports are given for 247 cities.

A HISTORY OF SOCIALIST THOUGHT—By Harry W. Laidler, Ph.D., Executive Director, League for Industrial Democracy; Author of "Socialism in Thought and Action," "Boycotts and the labor Struggle," etc. [Crowell's Social Science Series, Edited by Sera Eldridge, Department of Sociology, University of Kansas.] New York: Thomas Y. Crowell Co. Cloth; 6x8 in.; pp. 713; frontispiece and 13 other portraits. $3.50 net.

THE PANAMA CANAL: Its History, Activities and Organization —By Darrell Havenor Smith. (Institute for Government Research), Service Monographs of the United States Government, No. 44.) Baltimore, Md.: The Johns Hopkins Press. Cloth; 6x9 in.; pp. 413. $2.50.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Full Study of Mississippi Needed

Sir—In your issue of May 5 I have read with interest your editorial on "The Problem of the Mississippi"; I have also read other contributions in that issue pertaining to this subject. I have been impressed with the thought that the writer of your editorial and the writers of the various contributions published in this issue of May 5 are people who are not familiar with the tributaries of the Mississippi River coming in from the west, other than possibly the Missouri River, the Arkansas River and the Ouachita River, and the lower portion of the Red River.

To me it looks as though the great danger in connection with the working out of the flood problem on the Mississippi River is that it will not be given the broad study that the subject requires.

Back in the early days protection from high water in the lower Mississippi was secured by the construction of levees. Apparently the only remedy that has been thought of was more levees and the raising from time to time of the levees originally constructed.

As stated in your editorial it has been a popular alibi of writers on flood troubles to lay it to deforestation and apparently they have been satisfied to harp on that subject.

Nothing has come to my attention in the various writeups on the flood situation regarding the influence of the immense amount of work that has been done in the past twenty years in Iowa, Missouri, Illinois, Arkansas, Louisiana, Kansas and Oklahoma in the formation of drainage districts for the prevention of overflow of bottom lands along the various streams in these states, which lead into the larger tributaries of the Mississippi River.

The straightening of channels and construction of cut-offs of streams during the past twenty years in the territory mentioned above has had a big effect in conveying flood waters more rapidly into the larger tributaries of the Mississippi River, resulting in the more rapid rise of the main river.

No flood waters have been contributed to the Mississippi River during the present flood stage from the main Arkansas River, from the Salt Fork, Cimarron, North Canadian, South Canadian and Red Rivers from points west of the central part of Kansas and central Oklahoma. All of these rivers are subject to very disastrous floods caused by rainfall west of the center of these states.

In 1903 a disastrous flood occurred at Kansas City due to floods at the same time in the Missouri and Kaw Rivers west of that point, yet neither the Missouri nor Kaw River was at flood stage west of Kansas City during the present flood. The Ohio River also was not at flood stage in the Pittsburgh district.

Therefore, there is a possibility if not a probability that at some time in the future a condition may arise in which these tributaries, which were not at flood stage in their upper regions this spring, may add their flood waters to an amount of flood water equal to what we have at the present time in the lower Mississippi.

It is evident, therefore, that there should be a thorough study made of this whole situation, and the danger is that it will be confined to a study only of the Mississippi River from the mouth of the Ohio south.

The failure to recognize the possibility of heavy flood waters from tributaries west of the Mississippi makes an impression on one who has been familiar with these western tributaries for the past forty years; and raises the fear which I have expressed, that the study of this flood problem may be on too small a scale.

It would look to one from simply studying the map that an overflow channel from a point north of Baton Rouge down through the Atchafalaya River is a possibility that should not be overlooked.

Serious consideration should be given to the question of whether levees are the main thing to depend upon. It looks as though they may have been overworked, and that other ways of handling the flood waters of the lower Mississippi had not been given sufficient study.

C. A. MORSE,
Chief Engineer, Chicago, Rock Island & Pacific Ry.

Chicago, Ill.,
May 9, 1927.

Velocity of Approach in Dam Design

Sir—The writer wishes to join with Prof. Hardy Cross in his condemnation of a tendency of modern text books to include velocity of approach as an element of force in the overturning moments of dams. (See Professor Cross's letter, "Figuring Velocity of Approach in Dam Design," *Engineering News-Record*, March 24, 1927, p. 500.)

It seems that he might have been even more emphatic in his statements. Certainly water flowing over a dam does not exert as much pressure on its face as though it were held at the height of the water surface back of the

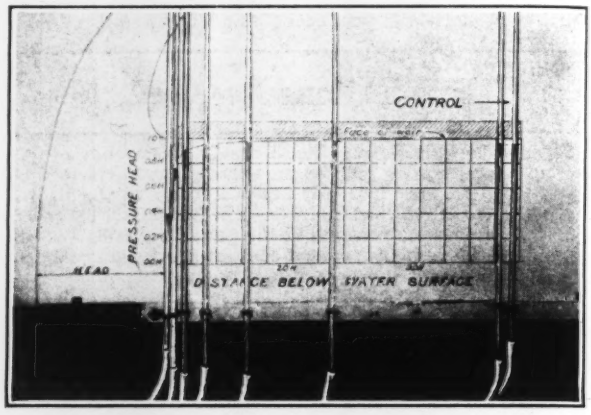


CHART OF PRESSURE HEADS BACK OF WEIR

dam by flashboards. In fact the pressure is less than that due to the simple static conditions ordinarily assumed.

For proof of this statement I submit a photograph showing the pressure heads back of a weir. The tube marked "control" indicates the level of the water six feet from the weir. The other tubes, which are arranged in the photograph to show the pressure at various distances below the crest of the weir, show that the pressure decreases with increase of velocity of water approaching the lip of the weir.

The decrease in pressure back of a weir is more fully discussed in Bulletin 22, Engineering Experiment Station Series, University of Washington, Seattle, Wash., entitled, "An Analysis of the Weir Coefficient for Suppressed Weirs," by Prof. C. W. Harris. This was reviewed in *Engineering News-Record*, Sept. 18, 1924. p. 470.

J. B. HAMILTON,
Department of Civil Engineering, University of Washington.

Seattle, Wash.,
Apr. 12, 1927.

Sir—Regarding the letter by Prof. Hardy Cross headed "Figuring Velocity of Approach in Dam Design," in *Engineering News-Record*, March 24, 1927, p. 500: While in the low water season the water upstream from the spillway of a masonry dam is virtually a pool, often with very slight velocity, there is frequently an entirely different condition at times of flood flow, when a decided velocity of approach may exist in the whole cross-section of river just upstream of the dam. Then the head on the crest of the dam, usually measured a short distance upstream, is an index of the static pressure on the back of the dam. The dynamic pressure due to impact of the flowing water upon the back face of the dam is not included in the static head, however, and represents an additional force acting on the dam, not usually large in amount or important, but nevertheless present. The estimation of this force also utilizes one of the fundamental principles of mechanics, which the student should keep before him.

The writer therefore does not concur with Professor Cross, that this subject should be omitted from the literature of design of dams.

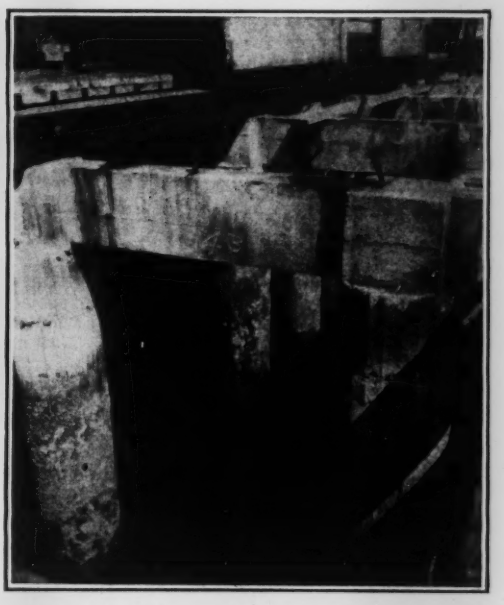
H. K. BARROWS,
Consulting Engineer.

Boston, Mass.,
May 2, 1927.

Better Success with Concrete in Sea Water

Sir—In *Engineering News-Record*, Feb. 10, 1927, p. 251, there was published a letter from the undersigned under the same heading as above, presenting facts about the successful use of plain and reinforced concrete in the port structures along the San Francisco waterfront. The statement was made that the first precast reinforced-concrete piles were used in 1911 and that the first pier in which the timber piles were protected by precast reinforced-concrete jackets was constructed during that year.

In the pier referred to, which is 800 ft. in length and contains 1,130 jacketed piles, steel I-beams encased in concrete were used as caps over the piles and the deck consisted of timber stringers and planking. The concrete piles, 137 in number, were used in the adjacent wharf in which the deck was of reinforced concrete. In repairs to the timber deck of the pier, photographs were taken to show the condition of the piles, the pile jackets, the reinforced-concrete wharf deck and the concrete encased steel beams. The accompanying photographs taken March 25 show conditions typical of the entire structure and indicate that it is in excellent condition after more than 15 years of service.



REINFORCED CONCRETE AFTER 15 YEARS OF SERVICE ON SAN FRANCISCO WATERFRONT

At right—Concrete jacketed piles and concrete-encased steel beams of pier 17. At left—Precast piles of wharf adjacent to pier 17.

San Francisco, Calif., April, 2, 1927.

FRANK G. WHITE,
Chief Engineer, Board of State Harbor Commissioners.

Flood Prospects in the Colorado Delta

Sir—In the fall of 1926 the Imperial Irrigation District conducted quite an extensive survey in the Colorado delta, in which I took part. Conditions observed during this survey throw some light on flood prospects in the delta.

A control line was run from the lower end of the Pescadero Cut about S 36 deg. W for a distance of about 11 miles. This line followed as nearly as possible the crown of the alluvial cone recently built. From the control, cross lines were extended east and west at intervals of a mile intercepting small leads parallel to the main cone.

At the time of the survey the discharge of the river through the Pescadero Cut was about 4,500 sec.-ft., and it was estimated that probably two-thirds of this flow was pitching to the west. Cross lines run in that direction encountered swamp and lake conditions, showing that the water had inadequate getaway facilities at the lower end. This is probably true. The principal channel draining this swamp area at the south end is the Pescadero, traversing a region of tenacious clay. The channel is about 100 ft. wide; with banks nearly vertical and resistant to rapid erosion.

The summer flood this year will probably be in the neighborhood of 130,000 sec.-ft. If the bulk of the water pitches to the west of the newly formed cone, the Pescadero will not be able to handle it. There will be a ponding effect, a great deposition of silt, and the basin now existing will be partially filled. The tendency will be for the water to spread to the west, and next year the fight will be along the Volcano Lake levee—last line of defense to Imperial Valley.

One other point I believe worthy of mention is: The tides at the head of the gulf are large. A bore travels up the funnel-shaped estuary for many miles, and as the water retreats it has a scouring effect and drags out considerable material. For the past few years practically no silt or drift has reached the sea. The cycle at the mouth of the river within tidal range has been one of scour only. If the river is controlled by means of an impounding reservoir many miles upstream, and the silt and drift load is cut off forever, will the sea encroach in years to come?

Tucson, Ariz., April 11, 1927.

GLENTON G. SYKES.

The Wanaque Aqueduct Controversy

Sir—Having been formerly a member of the engineering staff of the North Jersey District Water Supply Commission, the news item appearing in *Engineering News-Record*, May 5, 1927, p. 746, was of considerable interest to me. The courage of the commission in substituting the recommendations of Col. George A. Johnson for those of its own engineers in the face of almost certain criticism of its three years' deliberations in reaching this final decision seems remarkable!

Although the merits of the two types of construction may be open to question, it was only after a thorough and impartial investigation of the ways and means available for transporting water from the Wanaque reservoir to the various points of distribution that the commission's engineers finally made its recommendations. The supposedly final location of the aqueduct was run out, property surveys made and no small amount of property purchased along the aqueduct right-of-way, the disposal of which will be another problem in the light of this latest decision. Why this commission should go so far afield to have the opinions of its individual members confirmed is a matter for much speculation.

Engineering News-Record would be doing a distinct service to the cities and towns in the North Jersey District as well as the engineering profession at large in obtaining and presenting the pertinent facts in the case. If the economy of steel pipe construction is such as to warrant the complete revision of plans and the disposal of much of the real estate already acquired, all in the face of the opposition of its own engineering staff, it is indeed a subject to interest all water-supply engineers.

Cambridge, Mass., May 13, 1927.

SAMUEL M. ELLSWORTH.

[Further reference to this subject is made in our news pages, following.—EDITOR.]

News of the Week

Current Events in the Civil Engineering and Contracting Fields

World's Economic Ills Diagnosed at Geneva

Leaders of Forty-Seven Countries Meet to Discuss Means of Recovery

By E. J. Mehren
Vice-President, McGraw-Hill Publishing Co.

Geneva, May 5.

FOR two days representatives of forty-seven countries have been listening to a diagnosis of the world's economic difficulties. Twelve countries have been heard from. The encouraging feature is that the diagnoses agree—surely a good basis for the discussion next week, in committee, of the details of remedies.

It is an interesting gathering. The western world dominates in numbers but even its composition shows variations that give the interest of wide diversity. The British and the French and the Germans are here in all their strength; but equally imposing in size of representation, by delegates and experts, are Poland, Austria, Bulgaria, Esthonia, Hungary and Latvia, while Czechoslovakia outdoes all comers with its numerical strength.

Then there are such other new comers in the society of nations as the Free City of Dantzig and the Irish Free State. The British Empire registers strongly with its dominions and India, the Orient contributes Japan, China and Siam, and Africa sends Abyssinia Latin America is well represented.

Then Russia is here. That was the high excitement of the initial days of the conference; looked on as a favorable omen. Not that anyone believes in the rapid conversion of the Bolshevists from their program; but they come, they listen, they confer—that is considered progress. Their country is looked upon as a formidable element in the economic world. If confidence in her government can be developed, trade will grow on that confidence and Russia with large consuming power could be an important factor in European recovery.

America's presence, too, brings frequent and commendatory comment.

Such, then, is the setting. Truly a "society of nations" as tongues other than English describe the League of Nations.

The Diagnosis

What is the diagnosis on which the speakers, each speaking for his delegation, so far agree? There are, so they indicate, a number of diseases: First, that purchasing or consumptive power was curtailed by the war; second, that many trade barriers, and not merely high tariffs, have been erected, such barriers as fluctuating exchanges, high freight rates, troublesome customs formalities, quickly changed tariffs, which discourage long-time contracts, etc.

Of these diseases the restriction of purchasing power was most frequently stressed, but suggested remedies were not so readily forthcoming. Prof. Karl Gustav Cassel (Sweden), in a learned address, intimated that the restored purchasing power of backward countries might be a powerful stimulus if capital for their development were forthcoming in larger volume, and Karl F. von Siemens (Germany), again by intimation, pointed out the burdens to industry caused by the expansion of government functions and government intervention in industry. Dr. Zimmerman (Holland) also developed the same thought. Enlarged government functions withdraw men from productive enterprise and make them a tax on industry and thus on consumption. Government interference also burdens industry. The result is the reduction of purchasing power. Among government interventions Herr von Siemens cited high customs tariffs not justified by natural differences, import prohibitions, export bounties and wage regulation. All these mislead industry into self sufficiency, discourage technical progress and, in sum, depress the standard of life.

As to trade barriers the International Chamber of Commerce, represented in the discussion by Walter Runciman, has proposed a well thought out series of remedies which have the concurrence of its twenty-two national committees in as many countries. Chief among these is a suggestion for stabilization of tariffs, that is, that tariffs shall not change too often and without due notice. On this subject there will be more later, when the conference resolves itself into committee.

Unemployment

Naturally the question of unemployment has been very fully traversed, for it is recognized as one of the most serious results of Europe's economic dislocation. It is inevitably tied up with lack of purchasing power and the remedy for the latter is necessarily found in the remedy for the former. But in the handling of this subject there has been a solicitude that goes beyond its consideration as a cold economic fact. The human distress is keenly expressed.

Right here let there be recorded another note frequently struck in the speeches—insistence that the chief responsibility of leaders of industry and government is to improve the living conditions of the people at large. Whether this is a new note in Europe—a new note for the employer—I do not know. Certainly it does not accord with the impression we have in America of a cast-iron class distinction that refuses to recognize the ills of others. In Herr von Siemens' address this was especially striking. Again and again he came back to this as a major objective of those in responsibility whether in government or industry.

One other point secured universal agreement—that nations are interdependent and that their dislocations re-

A.C.I. to Convene in Philadelphia

The 24th annual convention of the American Concrete Institute will be held in Philadelphia Feb. 28—March 1. This is the first time since the 1919 meeting at Atlantic City that the convention has been held in the East. The annual conventions in 1920, 1921 and from 1924 to 1927, inclusive, were held in Chicago; the 1923 convention at Cincinnati, and the 1922 convention in Cleveland. At the 1919 convention the Institute had a membership of less than 400 and it now reports a membership of more than 2,400. Nearly half of the membership in the United States is east of Pittsburgh.

Welding Society Establishes Miller Medal

By gift of a fund by Samuel W. Miller the American Welding Society has established a gold medal to be awarded annually "in appreciation of work of outstanding merit in advancing the art and science of welding." It is to be known as the Miller Medal, according to announcement by resident F. M. Farmer.

Mr. Miller has been prominent in the welding field for many years. At present he is consulting engineer to the Union Carbide & Carbon Research Laboratories. He is a past-president of the American Welding Society.

Engineering Fifty Years Ago

From *Engineering News*, May 19, 1877

IF WE would single out the leading features which characterized the late Convention of Civil Engineers in New Orleans, it would be the princely generosity of the various railway companies which provided free transportation for so great a distance for so many people, the magnificent hospitality with which the members of the American Society and their guests were entertained by Capt. Eads, through his assistant, Mr. Corthell, and the sociability and good feeling that prevailed throughout the entire proceedings both in the meetings of the Society and in the excursions following.

act on each other. In fact the conference itself is the best evidence that the interdependence is a moving thought in Europe.

Of tangible suggestions was Herr von Siemens' comment on the conditions necessary for international cartels, a subject sure to receive much discussion. He suggested that they were feasible only under three conditions: (1) that the industries in countries concerned must be accustomed to co-operate and come to an understanding; (2) that constituent national groups can only be formed where the number of those concerned is not too large; and (3) that the agreements must cover a commodity which is clearly definable and also comparable.

Dr. Zimmerman stressed the growing importance for present industrial countries of their potential home market, since backward countries tend to establish their own industries and thus cut down their imports of manufactured goods. This means an effort to increase home consumption and therefore to raise the standard of living.

Mr. Jouhoux (France) proposed the organization of two economic bodies, one to meet at least every three years to lay out the policies for the second body, which would be a standing economic council to carry on through committees studies of important economic questions.

Finally, to an American, there was a special appeal in two points of Herr von Siemens' address: his appeal, first, for the preservation of individualism and, second, for openmindedness and flexibility in one's economic and industrial attitude. One might have been hearing an American in the forceful statement that "economic and technical progress is achieved in the first place by the industrious and untiring work of the individual and by his belief in the success of his endeavors. If individualism is eliminated from economic activities there can be no economic life." He pointed out that large scale organizations endangered individualism and that a main concern of the manager of such an enterprise is to nurture individual effort and initiative. May not his commendation of openmindedness contain the secret of Germany's remarkable industrial progress before and since the war?

Possible Results

What will be the result of this world conference?

The question is asked and answered dozens of times each day between sessions and in hotel corridors. The answer is always the same: Do not expect too much. The problems are extremely complex. The solution must be worked out slowly. But the groundwork can be laid here. The superstructure will come at a later similar gathering. Despite the difficulty, though, some early results are possible and may be expected.

Walter Runciman (England) put the broad fundamental well in these words: "Those who are concerned to maintain business prosperity in all countries are convinced that a mutual understanding in international, economic and business problems is the surest guarantee for a growing volume of trade and for the maintenance of the higher standards of life and comfort which are the legitimate aspirations of modern democracy."

Fire Protection Considered at Chicago Meeting

Association Holds Annual Meeting—Specifications for Industrial Buildings Adopted

Tentative adoption of specifications for building construction, so far as fire protection is concerned, was perhaps the most important definite action taken by the National Fire Protection Association at its annual meeting held in Chicago May 9-12. These specifications cover construction in heavy timber framing, reinforced concrete and protected steel. There was practically no discussion. An initial report by a new committee on the design, construction and fire protection equipment of motor-bus garages was discussed at some length, and suggestions were made that the committee also deal with public garages and service stations. Other reports relating to buildings included revised regulations for the protection of openings in walls and partitions, and regulations for exits and exit facilities of public structures.

Vaults and record rooms were the main subjects of a report by the committee on Protection of Records, dealing with the construction and the fire exposure conditions. Record rooms are classed as enclosures of fire-resistive construction for records which are too extensive or not of sufficient importance to justify the provision of vaults or safes. Such rooms should have a two-hour fire resistance. Both makers and purchasers of vaults, safes and filing equipment are warned to consider engineering test data and not to be governed by price conditions only.

Prevention of dust explosions in starch factories, flour and feed mills and grain elevators was the main subject of a report which also included regulations for reducing fire hazards in the pulverizing of sugar, cocoa, and fuel. Fuel pulverizing includes central and unit systems, the latter not requiring storage bins. The committee on Flammable Liquids presented regulations for the construction of storage rooms, and also for the construction and operation of gasoline tank trucks and for marine oil terminals. Revised regulations were submitted by other committees for the installation and operation of compressed gas systems, gas systems for welding and cutting, blower and exhaust systems for ventilation or the conveying of materials, and the installation of pipe and hose.

About 535 members and visitors were registered during the four-day session. Officers elected include the following: President, Dana Pierce, Chicago; vice-presidents, Allen M. Schoen, Atlanta, Ga., and Frank C. Jordan, Indianapolis. The secretary, re-elected, is Franklin H. Wentworth, Boston, Mass.

Failure of Levees in Atchafalaya Basin Spread Mississippi Flood

Water from Red and Tensas River Valleys Breaks Through Levees Along Bayou des Glaises

INTEREST in the Mississippi River flood situation has been shifted to the valley of the Atchafalaya River, west of the Mississippi River in Louisiana, due to failure of levees near the mouth of the Red River. The Atchafalaya valley and a portion of the Mississippi and Red River valleys are shown on the accompanying map. Previous to 1831 the Mississippi River made a large loop to the west at the mouth of the Red River. The Red emptied into the western end of this loop and the Atchafalaya drained out of it. In 1831 the loop was cut off leaving an isolated channel which is known as Old River.

Water from the Red River valley and from the Mississippi at times of flood, flows down the Atchafalaya River, and in order to keep it from cutting too deep a channel and possibly diverting the Mississippi from its main channel, two sills have been built across the Atchafalaya near Simmesport.

Levees along the south side of Old River connect the Mississippi levee system with that of the Atchafalaya, and from Simmesport west and north along the Bayou des Glaises to the higher land at Marksville connect the Atchafalaya system with that of the Red River. It is in the latter line of levees along the Bayou des Glaises that the failures of the past week have occurred. Those between the Mississippi and Atchafalaya are still holding, but as the crests of the Mississippi and Red River floods have just passed Old River the danger is not over although the break to the west of the Atchafalaya will tend to relieve the situation. These breaks also will help to relieve the flood

Historic Railway Pageant to Be Part of B. & O. Centennial

As part of the Baltimore & Ohio Railroad centennial, the company is planning an outdoor railway pageant to be held at Baltimore from Sept. 24 to Oct. 8 of this year. The company has set aside 1,000 acres of land at Halethorp, on the outskirts of Baltimore, as a centenary ground upon which it will construct a railway loop nearly 2 miles long, replicas of historic buildings and railroad structures, and a hall of transportation where the development of rails and ties, locomotives, cars and railroad appliances will be exhibited.

GAGE HEIGHTS AT LOWER MISSISSIPPI VALLEY POINTS

	Mississippi River						Red River	
	St. Louis	Memphis	Vicksburg	Natchez	Baton Rouge	New Orleans	Shreveport	Alexandria
Flood stage*	30.0	35.0	45.0	46.0	....	17.0	29.0	....
Provisional Levee grade**	....	51.5	58.0	57.5	48.1	25.2	....	....
1922	34.0	42.5	54.8	55.3	45.7	21.3	....	....
Previous high.. 1927	41.4	46.5	53.8	53.5	43.8	21.1	....	....
April 24	35.6	45.9	54.8	55.3	44.8	20.8	34.1	....
April 25	35.8	45.9	54.5	55.2	45.0	21.0	35.1	38.0
April 26	36.1	45.6	54.4	55.0	45.0	20.9	36.0	38.3
April 27	35.6	45.4	54.9	55.0	45.0	20.8	36.7	38.7
April 28	34.6	45.1	55.7	55.1	45.0	20.8	37.2	39.0
April 29	33.4	44.7	56.3	55.5	45.1	20.8	37.4	39.5
April 30	....	44.3	57.2	56.1	45.4	20.8	37.4	40.0
May 1	....	43.8	57.9	56.5	45.8	20.7	36.9	40.5
May 2	....	43.2	58.2	56.4	45.7	20.7	36.4	40.1
May 3	....	42.7	58.5	56.4	45.4	20.4	35.4	41.3
May 4	26.8	42.2	58.7	56.5	45.6	20.4	34.3	41.5
May 5	25.4	41.6	58.2	56.4	45.7	20.4	32.6	41.9
May 6	24.1	40.8	58.0	56.1	45.8	20.4	31.9	42.1
May 7	23.7	40.6	57.7	55.7	46.0	20.3	29.2	42.3
May 8	25.4	39.8	57.2		46.1	20.3	27.6	42.4
May 9	27.3	39.2	57.0	55.3	46.1	20.3	26.1	42.2
May 10	29.5	38.4	56.6	55.1	46.3	20.2	24.6	41.9
May 11	30.3	37.6	56.4	55.1	46.5	20.3	23.0	41.5
May 12	29.1	36.9	56.0	55.0	46.8	20.2	22.6	40.9
May 13	27.6	36.4	55.7	55.1	47.1	20.4	22.6	40.3
May 14	26.3	36.0	55.4	55.1	47.4	20.6	23.2	39.4
May 15	25.2	35.8	55.2	55.1	47.8	20.7	22.8	38.5
May 16	25.9	35.7	54.8	54.9	47.7	20.6	21.9	37.7
May 17	27.0	35.6	54.4	54.7	47.6	20.6	20.6	36.9

* Approximately a bank-full condition above which levees are required.

** Grade established by the Mississippi River Commission as the desired height for the levees.

situation in the lower Mississippi valley as the water which is now spreading over the parishes west of the Atchafalaya will reach the Gulf of Mexico without returning to the Mississippi.

The situation in this region as of May 17 is given in the following telegram from Major W. H. Holcombe, district engineer at New Orleans:

"No additional crevasses on levee line of Mississippi River. All main line levees in satisfactory condition but undergoing great strain due to stages already 2 ft. higher than ever before recorded with an additional foot predicted as possible. These levees already raised to withstand predicted stage but there is considerable seepage through levees not up to Mississippi River Commission section. Landside slides feared as small-section levees become saturated. Following crevasses on smaller streams: Some ten breaks on Bayou des Glaises levees during period May 11 to 15 and these levees have been abandoned. This water is flooding Atchafalaya River basin on the west side from whence it will find its way to gulf without returning to Mississippi River. Crevasse occurred 5 a.m. this date 800 ft. south of Melville, La., on west bank of Atchafalaya River from which waters will join with crevasse water from Bayou des Glaises. Above crevasses on Bayou des Glaises and Atchafalaya River will check the anticipated rise on Mississippi River but will give only partial relief as a great volume of water from old crevasses between point opposite Vicksburg and mouth of Old River is slowly descending towards Old River. Crest of this crevasse water flood is now at Ferriday, La., about seven days away from Old River. Moderate stage prevailing at New Orleans with practically no rise predicted and levees around city able to withstand much higher stage."

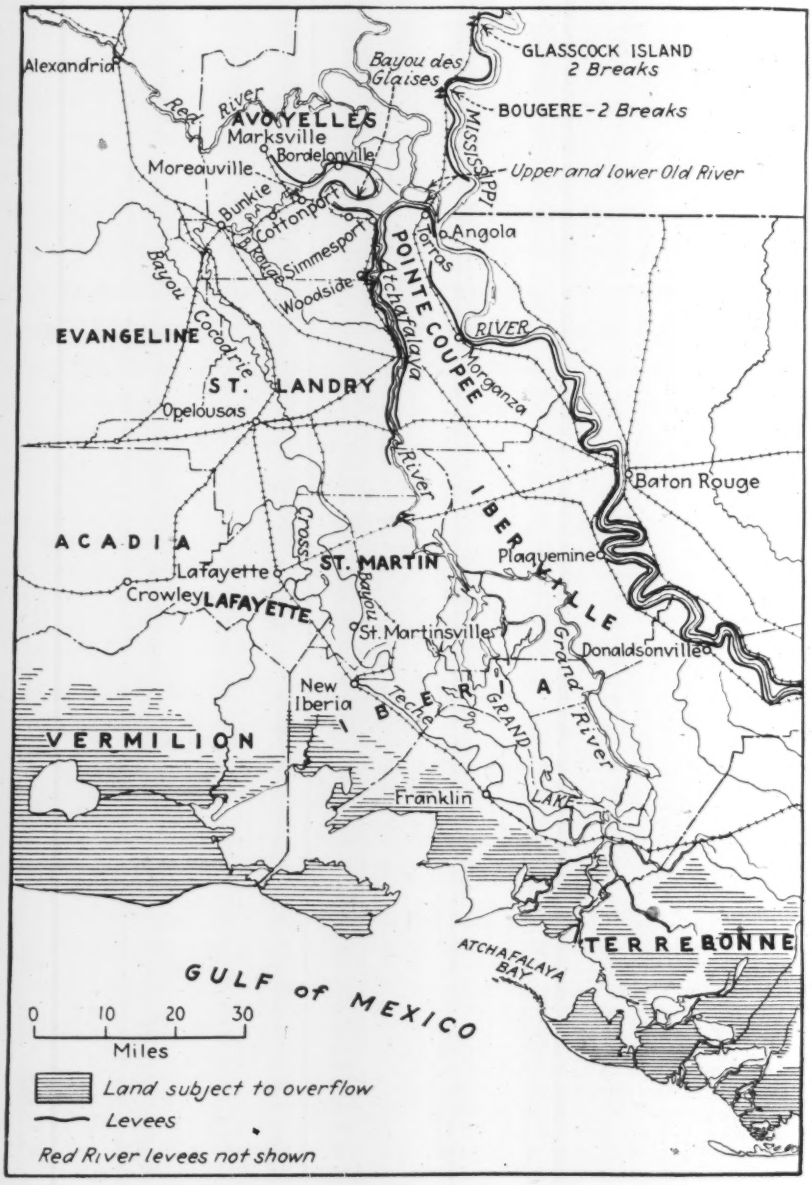
Melville, the point on the west side of the Atchafalaya River where Major Holcombe states a crevasse occurred on May 17, is about 13 miles below Woodside, shown on the accompanying map.

The situation in the Vicksburg region is given in the following dispatch from Major J. C. H. Lee, Corps of Engineers, Vicksburg, dated May 17:

"The flood situation in the third Mississippi River Commission District on May 17 shows continued improvement. All danger of further crevasses in the district is practically over. The Vicksburg gage is 54.4 falling at the rate of about one-half foot daily. The South Bend crevasse on Arkansas River has ceased flow-

ATCHAFALAYA RIVER VALLEY, LOUISIANA

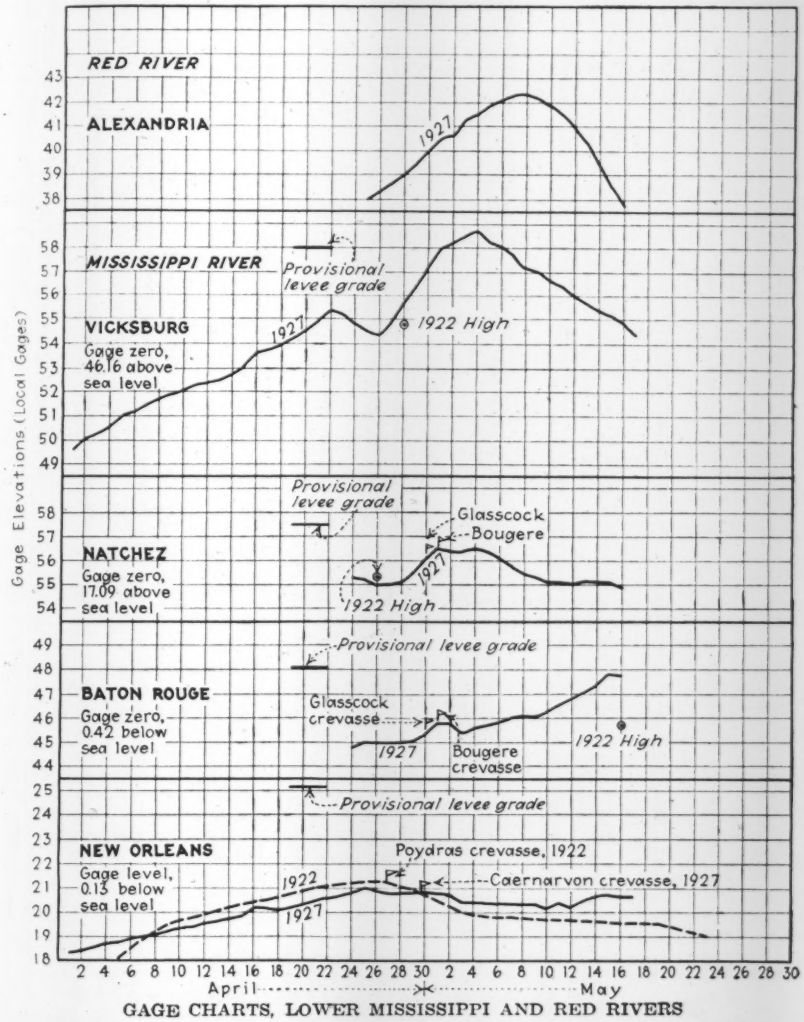
Showing location of Bayou des Glaises levee system and parishes subject to overflow. No breaks have occurred in levees east of the Atchafalaya River. Location of numerous breaks in Bayou des Glaises levees not shown.



ing and the Medford crevasse (Pendelton) has only a normal flow. The overflow on the Arkansas River has been entirely relieved above Dumas, Ark., at Arkansas City the overflow has fallen 6 ft. In Mississippi the Mound Landing crevasse (Stopps Landing) continues to discharge into the interior. The river and backwater are falling at the rate of about a foot every three days. Total fall at Greenville and Leland has been about 3 ft. In Louisiana the Cabin Teele crevasse (Milliken Bend) continues to widen slightly although both the river and overflow water are falling at the rate of about 0.4 ft. daily. Considerable territory is being freed of overflow on both sides of the river daily and the movement of refugees and stock back to their homes has commenced in considerable numbers."

An encouraging report of conditions at New Orleans comes from Roger B. McWhorter, special engineer of the New Orleans Levee District, in the following telegram:

"Because of the numerous crevasses in Bayou des Glaises Levee the rise in lower Mississippi River has been checked. Carrollton gage is not expected to again reach 21 ft. Caernarvon crevasse has widened somewhat at lower end during the last week and discharge has increased materially. Estimated that 230,000 sec.-ft. now passing through crevasse. Situation at New Orleans is entirely satisfactory but serious in Atchafalaya basin."



GAGE CHARTS, LOWER MISSISSIPPI AND RED RIVERS

Since this chart was published last week the crest of the flood has passed Baton Rouge. The time when the major crevasses in the lower river occurred is indicated upon the charts which they effect, also the days upon which the 1922 flood peaks occurred and the elevations are given. The relation of the local gages on the Mississippi to Gulf level is shown.

Testing Materials Convention Program Announced

The American Society for Testing Materials will hold its thirtieth convention at French Lick, Ind., June 20-24. The first meeting, the afternoon of June 20, will be devoted to registration and committee meetings. The opening general session will be held at 2 p.m. of June 21, at which time three committees will report and new officers will be introduced. The second and third sessions will be held simultaneously and will have to do with wrought iron, cast iron and magnetic testing, rubber textiles, coal and timber. The fourth session will be held at 8 p.m. June 21, at which time the presidential address will be heard and the report of the executive committee.

The fifth session on steel, and the sixth session on petroleum products, insulating materials and preservative coatings will be held simultaneously on June 22, beginning at 9:30 a.m. and at 4:00 p.m. will be heard the second Edgar Marburg lecture. This will be on "X-rays in Industry" by Dr. George L. Clark, professor of applied chemical research and divisional director of the research laboratory of applied chemistry of Massachusetts Institute of Technology. The eighth session, beginning at 9:30 on June 23, will be devoted to corrosion, endurance testing and wear testing of metals. The ninth and tenth sessions will be held simultaneously and these will have to do with non-ferrous metals and metallography, clay and concrete products and building stones. Simultaneous sessions will be held June 24 beginning at 9:30, one on cement, lime and gypsum, and the other on road materials and waterproofing. At the thirteenth session there will be a symposium on field control of the quality of concrete.

Water-Works Convention Program Arranged

The program arranged for the 47th annual convention of the American Water Works Association, to be held at Chicago, June 6-11, promises a full discussion of all phases of water-works engineering and operation. Registration will begin at 8 a.m., Monday, June 6, at Hotel Sherman, convention headquarters, and at 2:30 p.m. there will be a superintendents' round table discussion. Various committee meetings will also be held on the first day of the convention.

Forenoon and afternoon sessions are planned for the remaining four days, at which papers will be presented covering problems in design, construction and operation of water-works, and on Saturday there will be a forenoon session at which a discussion will take place covering the relation of sewage to the purposes of the association.

Chicago A.A.E. Establishes Award of Merit

Following the example set a few years ago by the Los Angeles chapter of the American Association of Engineers, the Chicago metropolitan chapter has instituted an annual "award of merit" to the engineer of some conspicuously important work, and more especially an engineer in executive position or handling the business side of engineering. At a dinner on May 14 the first Chicago award, in the form of an engraved diploma, was presented to T. Arthur Evans, engineer of design for the Board of Local Improvements, for engineering services rendered the city while having charge of the design and supervising the construction of Wacker Drive.

Many Engineers at National City Planning Conference

Regional Planning and College Courses for City Planners Discussed—Educational Work Gift

Engineering News-Record Staff Report

Outstanding features of the 19th National Conference on City Planning, held at Washington, May 9 to 11, were the many engineers included in the large attendance, the adoption of a joint report dealing with subdivision of land, prepared after much study by a joint committee representing the Conference and the National Association of Real Estate Boards, and a very interesting address, with which the Conference closed, on the replanning of Rome, Italy. Much attention was given to regional planning. A lengthy session was devoted to various phases of the work now in progress by the National Capital Park and Planning Commission. Not content with lengthy programs of the sort common to conventions, the Conference held "round table" discussions at all three of the daily meals, taking up zoning under the leadership of Edward M. Bassett, and college instruction in city and regional planning, led by Prof. James S. Pray, chairman, School of Landscape Architecture, Harvard University.

BARTHOLOMEW PRESIDENT

As president for the ensuing year, the Conference elected Harland Bartholomew, for many years engineer of the St. Louis City Plan Commission and now city plan consultant with offices in the city named. The announcement was made of a grant of $3,000 for educational work in city planning, effective beginning June 1, by the Russell Sage Foundation, together with a possible $3,000 additional provided $9,000 for the purpose named was raised otherwise. Among resolutions adopted by the Conference before its adjournment was one urging all state and local authorities to limit both the bulk and height of buildings and bringing the importance of this matter before Congress as regards the District of Columbia; one approving the uniform motor vehicle code suggested by the Hoover Conference on Street and Highway Safety; and one providing for the creation of a committee to consider the advisability of having the United States census taken every five years.

In reviewing twenty years of progress in city planning, President John Nolen stated that almost no comprehensive city planning had been done in the United States up to 1905. Now 157 cities have been broadly replanned, official zoning ordinances have been adopted by 460 cities, and 390 cities have city planning commissions. In the course of extended discussion of city and regional planning occupying two sessions, Gordon Whitnall, director of the Los Angeles City Plan Commission, set the future population limit of the Los Angeles regional district at 12,000,000. Asked for an explanation, he stated that it was due to the fact that in the allotment of water to be developed from the Colorado River, only sufficient for that number of people would be available to the region.

One of the dinner round table subjects for discussion was "Economic Height of Buildings," led by J. Rowland Bibbins, consulting engineer, Washington. Mr. Bibbins was somewhat chary of answering his own question, "What is the true economic height of a building?" because of the complications involved. Among other things he said: "When all engineering, economic and accounting factors are considered, I strongly suspect that in the usual high-value districts of our large cities, the true economic height will be closer to ten stories than twenty. Later we may be able to prove this." The consensus of opinion throughout this entire discussion was strongly against very tall buildings. The only one who seemed inclined to raise his voice to the contrary was a representative of an association of building owners and he was quite willing that tall buildings should be zoned as to use, although not as to height. In contrast, a representative of an important real estate association in a city of considerable size spoke very strongly against tall buildings, going so far as to assert that in effect they rob the many for the benefit of the few.

The report of the Committee on the Regulation of Land Subdivision, mentioned in the opening paragraph, was submitted by Morris Knowles, consulting engineer, Pittsburgh, Pa., and chairman of the plan commission of that city. Among other things the committee recommended that (1) state planning enabling acts should be passed in the various states; (2) that master plans be adopted in each city and extend beyond the city limits; and (3) that the city plan commission should adopt regulations covering drainage and various other matters.

The concluding feature of the conference was an illustrated lecture on "The Rebirth of Imperial Rome," by Henry Burchell, Secretary of the Italy-American Society.

Stanford May Drop First Two Years from Curriculum

Ray Lyman Wilbur, president of Leland Stanford, Jr. University in California, has suggested to the board of trustees of that institution the abolition of the first two years of the undergraduate curriculum. It is not proposed that the new plan should go into effect at once but that it begin year after next and be in full operation by 1934.

The conditions which make such a move advisable, according to Wilbur, are that more than 30 junior colleges are now established in California alone, and these institutions are duplicating almost exactly the work students do in the first two years of a college course.

The junior college plan offers a certain amount of higher education to those who would not complete a four-year college course and at the same time makes it possible for the colleges, by higher entrance requirements, to go much farther in the four-year course for those who can take this work. Wilbur looks on the move he proposes as the logical sequence of present tendencies in education

Aqueduct Work Taken from Pratt and Sherrerd

Commission Puts Wanaque Work in Charge of G. A. Johnson—Size of Steel Conduits Unannounced

The North Jersey District Water Supply Commission, acting as agent in providing an additional water supply for Newark and other communities, voted on May 6 to relieve its chief and consulting engineers, Arthur H. Pratt and Morris Sherrerd, from responsibility for the design and construction of the remaining portion of the aqueduct between the Wanaque reservoir and Newark and to place the work in charge of Col. George A. Johnson, consulting engineer, New York City, with instructions to provide twin smooth bore steel conduits for the upper end of the aqueduct, to carry 150 m.g.d. The size of the steel conduits, one of the main points in the controversy, is left for future determination.

The earlier stages of the controversy over whether the Pratt and Sherrerd plans for a 9¼-ft. grade line concrete aqueduct, adopted by the commission in 1924, should be abandoned in favor of steel was noted in *Engineering News-Record*, May 5, 1927, p. 746, and was the subject of editorial comment in the same issue, p. 715. Since then the Borough Council of Glen Ridge, one of the municipalities in the district, has protested against the change of plan long after it signed a contract with the commission and has declared that it will not pay any increase in price due to the change. The Town Commission of Montclair, headed by its mayor, Henry A. Lardner, vice-president, J. G. White Engineering Corporation, New York City, has called a conference of the municipalities in both the water district and the Passaic Valley Sewerage District, some twenty in all, to meet at the Montclair municipal building on the evening of May 26, to consider "ways and means" of securing accurate information as to the plans for the future development of these two projects, to provide means of protecting the citizens of the various participating municipalities from being taxed an amount in excess of that which they had a right to expect under the contracts executed by them and to formulate plans, if this proves to be desirable, for better representative contact with "the two commissions."

Engineers representing Newark and Kearney, it is stated, have made reports favoring the change from concrete to steel. Clemens Herschel, consulting engineer and a resident of Glen Ridge, has made a statement to the authorities of that borough strongly condemning the action of the commission.

As stated on May 5, the request of *Engineering News-Record* for copies of the series of reports by Colonel Johnson and by Messrs. Pratt and Sherrerd were denied by the commission, on the ground that it would not be advisable to give out the reports until the route of the steel conduits had been determined on. A renewal of the request, after the subsequent ousting of Messrs. Pratt and Sherrerd has resulted in no response as yet.

Board of Review Reports on Everglades Drainage

A report has just been rendered to Governor John W. Martin of Florida by a board of engineers appointed two months ago to review the plans and improvement works of the Everglades Drainage District. The board was composed of Dean Anson Marston of Iowa State College, S. H. McCrory, of the Department of Agriculture, and George B. Hills of Jacksonville.

The report generally approves the plan drawn up in 1913 by an engineering board headed by the late Isham Randolph of Chicago, and since used as the basis of the improvement work carried on by the drainage district. It proposes some important modifications of the general project however.

Control of Lake Okeechobee will require 50 per cent increase of the outlet capacity now provided by the St. Lucie canal, the board finds. This may be furnished by a 5-ft. increase of depth of the St. Lucie canal or by provision of adequate discharge capacity in the Caloosahatchee River. Diversion of the Kissimmee River or outlet construction southward from the lake is rejected as impracticable. The lake level is to be regulated between a maximum of 17 ft. and a minimum of 14 ft., though the latter point may be passed in extreme years.

Construction of or raising of the levee around the south, west and east borders of the lake to a height of 27 ft. is recommended, to give adequate protection of the surrounding lands against wind tides.

Progressive construction of drainage canals for the region surrounding the lake is recommended, preferably by canals running direct to the sea in the shortest possible line. These canals are to be diked. They would be located generally 6 to 8 miles apart, and would run east and west rather than diagonally as at present. The immediate construction program is to comprise the increase of lake outlet capacity and the construction of the levee around the lower end of the lake, involving a cost of $5,000,000 to $8,000,000. Drainage canal construction is to be carried on progressively later on. The project will cost in the neighborhood of $26,000,000, and will drain from 2,000,000 to 3,000,000 acres of land.

The engineering and administration of the project in the past is endorsed as competent, efficient and economical, and the expenditures made so far in the construction of the drainage works are said to be reasonable.

Delaware and Other Rivers to Be Given Interstate Study

Acting under the authorization and direction of the Public Service Commission of Pennsylvania, F. Herbert Snow, chief of the Bureau of Engineering of that body, is about to make studies of water supply and related problems in Eastern and Southeastern Pennsylvania, especially of the Delaware, Lehigh, and Schuylkill rivers and their tributaries. Mr. Snow has notified various state and local governing and administrative bodies in Pennsylvania, New York and New Jersey that tentative plans for the studies are now being made for consideration at a proposed conference of engineering representatives of the various agencies already mentioned.

Up to May 3, Mr. Snow informs *Engineering News-Record*, the public service commissions of New York and New Jersey and the Tri-State Delaware River Commission have expressed their willingness to co-operate.

U. S. Committee Formed to Aid Haifa Technical College

To further the development of the Haifa Technical College, Haifa, Palestine, and thereby to assist in the scientific and industrial development of the entire country, the American Scientific Committee has been formed, under the chairmanship of L. S. Moisseiff, with headquarters at 5 Columbus Circle, N. Y. The executive committee includes such well-known engineers as S. M. Swaab, Max Toch, and Lazarus White. Alfred E. Kornfeld is treasurer.

The committee aims to secure the co-operation of American men of science and technology to enlist able minds in the task of directing the scientific development of Palestine, and to raise funds for the development and support of the college. Future plans include the development of a research laboratory and a standards institution.

Brief News

On May 8 Drilling Was Started at the Detroit end of the proposed Detroit-Windsor bridge, an 1,850-ft. suspension span. The site of the first work was at 21st and Fort Sts.

An Agreement Has Been Signed by the states of New York and Vermont to provide for the construction of a bridge across Lake Champlain from Fort Frederick, N. Y., to Chimney Rock Point, Vt., in accordance with the recommendations of an interstate commission which during the past year investigated the various proposed sites for a crossing over the lake. The agreement is to be effective at once.

On May 11 Governor John W. Martin of Florida announced that $10,000,000 of Everglades drainage bonds had been purchased by Dillon, Read Co. and Eldredge & Co., New York City. The same concerns are to finance the project throughout. This issue was made under the new law authorizing an issue of $20,000,000 of additional bonds, besides refunding the $11,000,000 Everglades Drainage District bonds now outstanding.

The City of Wheaton, Ill., with 6.000 population and a mayor-and-commission form of government, has passed an ordinance creating the position of city manager, with a salary of $4,800 annually. The mayor has appointed A. M. Jens as city manager, and he will also be city clerk, with an additional salary of $1,200.

Los Angeles County Sewer Project Well Under Way

The sewer construction project of the Los Angeles County Sanitation Districts is now being shaped in conformity with the recent decision of the California State Board of Health, announced in *Engineering News-Record*, April 21, p. 666, authorizing the construction of an ocean outfall at White Point. The law providing for the formation of such districts in California became effective in August, 1923, and immediately thereafter proceedings were begun for the formation of several sanitation districts to serve parts of Los Angeles County which are connected to the Los Angeles sewerage system.

With a comprehensive scheme based on ocean disposal, bond elections were carried in February, 1925, and construction work was begun in September of that year. At present many of the interior trunk lines of the system have been completed and because of urgent need in the area affected construction is being rushed on the remainder. The main features of the outfall project will be a tunnel three miles long through the San Pedro hills, and a submarine tunnel extending 5,000 ft. into the ocean. The permit is for the discharge of "settled sewage" to which the original application for "screened sewage" was subsequently changed. The outfall can be completed, according to A. K. Warren, chief engineer of the County Sanitation Districts, in a year and a half.

The total cost of the trunk line system will be in excess of $10,000,000 which does not include the lateral sewers being constructed under local assessment proceedings. When completed the sewer system will serve 432.6 sq.mi., comprising the major portion of the Los Angeles metropolitan area outside the city limits. Included in this area are 28 incorporated municipalities.

Canadian Government Refuses to Renew Large Power Lease

Another chapter has been written in the controversy which has raged for years over the Carillon Rapids on the Ottawa River in Canada, by the refusal of the Dominion Government to renew the lease of the National Hydro Electric Co. This lease, which expired April 30, gave the company the right to develop 300,000 hp. at Carillon. The company now falls back on an old lease which provides for the development of only 250 hp. It is altogether likely that the government will now proceed to buy out the old lease, which will mean that the power development of the Ottawa River will be once more in the hands of the federal authorities.

Just what will follow is problematical. The belief persists in many quarters that the Dominion Government will undertake development of Carillon itself. It is estimated that something like 400,000 hp. could be produced at the Carillon Rapids incidental to the deepening of the Carillon and Grenville canals from 9 to 14 ft. at a cost of $40,000,000.

Personal Notes

D. A. EVANS, formerly with the Newfoundland Power and Paper Co., Ltd., Corner Brook, Newfoundland, has joined the engineering staff of the Lake St. John Power and Paper Co., Ltd., Mistassini, Quebec. Mr. Evans is a graduate of the University of Wales. He was for a time with the National Transcontinental Ry. and later with the Canadian Pacific Ry. He went to Newfoundland in 1924.

ROY A. YINGLING, formerly with the Kentucky Rock Asphalt Co. on the development of its Kentucky property in Edmonson County and recently with the Perfect Classifier Co. of Nashville, Tenn., is now located at Bessemer, Ala., in the engineering department of the Tennessee Coal, Iron and Railroad Co.

C. H. LOVEJOY, vice-president of the Forest City Testing Laboratory Co. of Cleveland, Ohio, will be in charge of Toledo office of this company opening May 1 in the Nasby Building in that city. The company has been engaged to make complete tests, including core drilling, of the pavements included in Toledo's large paving program of this year.

H. L. CHRISTMAN, of Youngstown, Ohio, has been placed in charge of the branch laboratory and inspection headquarters that has just been established by the Pittsburgh Testing Laboratory at Youngstown, Ohio. Mr. Christman has been identified with general testing and inspection work for more than twenty years.

J. A. PIERSOL, superintendent of construction for the Marott Hotel Co., of Cleveland, Ohio, and who has just finished building for this company a large apartment hotel in Indianapolis, Ind., has been transferred to Cleveland as general manager of a land development and house construction project which this company is handling at Cleveland, known as the Indian Hills Estate.

FREDERICK W. HARTMAN, who has been city engineer at Iron Mountain, Mich., has been appointed city manager of Alma, Mich., filling a vacancy that has existed since WILLIAM E. REYNOLDS resigned last December. Prior to being city engineer at Iron Mountain, Mr. Hartman had been a field engineer for the city engineer's office of Grand Rapids, Mich.

E. D. JOHNSTON, a junior highway engineer in the Washington office of the Bureau of Public Roads, has been appointed an assistant highway engineer, on bridge construction, for District 6 of the bureau, and is located at Fort Worth, Tex.

C. R. ANDREWS has resigned as resident engineer in charge of the construction of the Starved Rock lock and dam on the Illinois River to accept a position as chief engineer for the Robert H. Smith Co., Inc., Milwaukee, Wis.

H. C. ROSE, who for seven years was connected with the Ontario Department of Highways as resident roads engineer, first at Guelph and then at London, has been appointed chief engineer of the Toronto and York Roads Commission. The appointment was made to fill the position left vacant by the death of the late E. A. JAMES.

W. W. MADDY, of New Concord, Ohio, formerly a field engineer for Stone & Webster, Inc., of Boston, Mass., has entered the service of the Corps of Engineers as an assistant hydraulic engineer in the Chattanooga District.

FREDERICK H. WEED, of New York, has become associated with Gannett, Seelye & Fleming, Engineers, Inc., of Harrisburgh, Pa., in charge of their civil engineering work. Mr. Weed is a graduate of Dartmouth, civil engineer, class of 1914. For the past seven years he has been assistant consulting engineer with James Fuertes of New York City and during this time has handled the filter plant work done by the cities of Harrisburg, Pa., and Denver, Colo.

CHARLES E. ANDREW, bridge engineer of the Washington State Highway Commission, has been appointed bridge engineer of the California State Highway Commission. Mr. Andrew, a graduate of the University of Illinois, went to Oregon in 1906 in the employ of Ralph Modjeski. He has been bridge engineer of the Washington Commission since 1920. His appointment in California, where he will fill the position formerly held by the late Harlan D. Miller, was effective as of May 1.

V. S. VEAZEY, formerly chief engineer of the Kanawha, Glen Jean & Eastern R.R., has just completed the location of 13 miles for the New York Central R.R. in West Virginia and is now in Daytona Beach, Fla. (Seabreeze Station), in the general practice of engineering.

L. B. ROBINSON, who has been in civil engineering practice in Elkins, W. Va., has been appointed city engineer of Elkins, succeeding N. G. SCOTT, who has resigned to engage in contracting in Elkins. Mr. Robinson served as city engineer of Elkins under a previous administration.

Engineering Societies

Calendar

Annual Meetings

SOCIETY OF INDUSTRIAL ENGINEERS, Chicago, Ill.; Annual Meeting, Chicago, Ill., May 24-27, 1927.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Chicago, Ill., June 4-6, 1927.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Tulsa, Okla., June 6-8, 1927.

AMERICAN INSTITUTE OF QUANTITY SURVEYORS, Chicago, Ill.; Annual Meeting, Washington, D. C., June 6-8, 1927.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Chicago, Ill., June 6 to 11, 1927.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, French Lick, Ind., June 20-24, 1927.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, New York City; Annual Meeting, Orono, Maine, June 27-30, 1927.

The Brooklyn Engineers' Club at its May 12 meeting elected the following officers: President, J. C. Riedel; vice-president, L. G. Nieman; secretary, Emil Bie; and treasurer, W. H. Wharton. At its May 19 meeting, the club is to have a joint lecture by D. B. Steinman and C. F. Goodrich on the design and construction of the Carquinez Strait bridge in California.

The Engineers Society of St. Paul at its meeting on April 25 had an address on "The Engineering Aspects of Forestry," by Dr. Raphael Zon, director of the U. S. Forest Experiment Station at the University of Minnesota. At the meeting on May 9, a paper on "Arc Welding of Structural Steel" was presented by F. H. Farmer, of the Westinghouse Electric & Mfg. Co.

The Detroit Engineering Society has elected these officers for 1927-1928: President, Wm. F. Zabriskie; vice-presidents, Charles J. Peck and John P. Hallihan; secretary and treasurer, F. A. Kimmich; managing secretary, E. L. Brandt.

Obituary

WILLIAM L. EKIN, chief engineer of maintenance-of-way of the western region of the Pennsylvania R.R., with headquarters at Chicago, died April 28 of heart failure in his office at the Union Station, Chicago, aged 47 years. Mr. Ekin was born in Xenia, Ohio, and educated at Ohio Wesleyan University and Case School of Applied Science. He entered railway service in 1900 in the maintenance-of-way department of the Cincinnati division of the Pennsylvania R.R.; in 1905 he became assistant engineer and later division engineer of the Michigan division of the Vandalia (now part of the Pennsylvania system). Transfer followed to the St. Louis division, the Peoria, Michigan, Conemaugh, and Philadelphia divisions, and in 1913 Mr. Ekin became general superintendent of the northern division. The next year he was appointed superintendent of the Philadelphia division and in 1926 engineer of maintenance-of-way of the western region.

M. J. HOGAN, Canadian contractor and railway builder, died at his home in Port Colborne, Ont., May 9, aged 78 years. In his early years he was connected with construction of parts of the Intercolonial Ry., and in 1885 was associated with the Dominion Bridge Co. in the construction of a railway bridge over the reversing falls at St. John, N. B. In 1901 he obtained the first contract for the improvement of Port Colborne harbor and during the past 26 years has carried out several contracts for the construction of docks, breakwaters, dredging and other improvements in the harbor.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer is Doing for the Engineer and Contractor

Wood Utilization Committee to Prepare Technical Pamphlets

Since the largest quantities of our forest products are used in building and construction activities, the National Committee on Wood Utilization at its recent meeting decided to prepare a series of technical pamphlets which will demonstrate proper building and construction practices.

Continued activities in promoting the use of lumber less than 8 ft. in length was authorized. In this connection a report will immediately be printed on the end matching of soft wood lumber.

Business Notes

NORTHERN CONVEYOR & MFG. CO., Janesville, Wis., is opening a permanent office in Binghamton, N. Y., under the direction of H. E. Whitnall, vice-president of the company. This office will handle the business of the New York and New England territories.

CLIMAX ENGINEERING CO., Clinton, Iowa, has recently appointed a number of new distributors: Hunter Machinery Co., Milwaukee, Wis., for Wisconsin and western Michigan; Belknap Hardware & Mfg. Co., Louisville, Ky., for Kentucky, northern Tennessee, West Virginia and portions of Virginia and North Carolina; and Woodward-Wight & Co., New Orleans, La., for southern Louisiana and southern Mississippi.

E. L. CROWE, formerly mechanical engineer with the Sessions Engineering Co., Chicago, is now sales engineer for the Joseph Harrington Co., a subsidiary of the Whiting Corporation, with office in the Railway Exchange Building, Chicago.

C. F. MESSINGER was made vice-president of the Stearns Conveyor Co. when that company was recently purchased by the Chain Belt Co., Milwaukee.

KENSINGTON STEEL CO., Chicago, announces the appointment of Arthur Whitcraft as Eastern sales manager with headquarters at Port Ewen, New York.

T. L. SMITH CO., Milwaukee, has appointed the George B. Curd Equipment Co., Cincinnati, as distributors of its products in the Cincinnati and Dayton territories.

LINK-BELT, LTD., Toronto, reports that the expansion in its manufacturing business has made necessary the purchase of about five acres of land and the start of a considerable building program; for the past 12 years the company has occupied only rented factories. The contract now under construction is a two-story building 80x160 ft.

GENERAL AIR FILTERS CORP., New York City, has recently appointed Dingle-Clark Co., Pittsburgh, as representative for its air filters, air compressors for internal combustion engines and electric motors and for its air washers, spray nozzles and spray ponds.

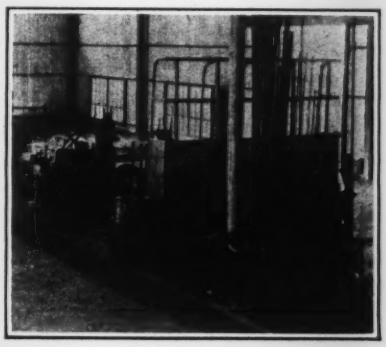
MUNDY SALES CORP., New York, announces the appointment of the Funkhouser Equipment Co., Kansas City, Mo., as its distributor in that territory. The Johnson-Beckwith Machinery Co., Davenport, Iowa, has also been appointed distributor in the Davenport territory.

READING IRON CO., Reading, Pa., announces that Harry L. Shepard, formerly in the department of the Chemist and Engineer of Tests, Union Pacific Railroad, has been appointed technical representative in the Chicago territory.

New Developments

Treatment of Drill Steels Controlled Automatically

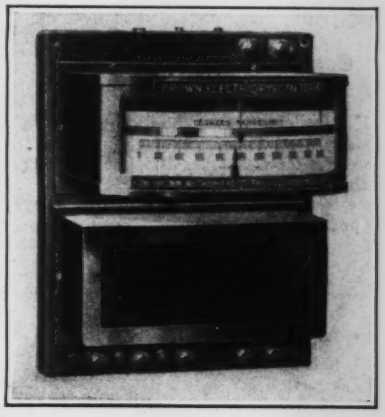
On large construction jobs requiring the daily use of many drill steels, mechanical drill sharpeners have become commonplace. The greater output



of these drill sharpening machines is one reason for the use of automatic heating, hardening and tempering machines. Another and probably more important reason is the guarantee of uniform quality. Automatic control makes necessary the use of registering and recording instruments and the Brown Instrument Co., Philadelphia, has perfected its control pyrometer for use on such heat treating equipment.

The above illustration shows a view of part of the shop of the Commerce Mining & Royalty Co., Cardin, Okla., showing a heat treating machine in the foreground and drill sharpener to the left. The heat treating machine is a self-contained rotary unit comprising an oil fired furnace, quenching tank, electric motor and mechanism for transporting drill steel from the loading table to its point of ejection. In passing through the machine each bit is automatically heated, hardened and tempered. Correct furnace temperature is assured by pyrometers.

It is said that this plant manned by



12 men is handling over 1,200 drill steels per day varying in length from 30 in. to 20 ft. for upwards of 150 rock drills. The heat treating machines are manufactured by the Gilman Mfg. Co., Boston, Mass.

The second illustration shows the Brown indicating and controlling pyrometer which can be operated directly from 110 or 220 volts a.c. or d.c. as specified. The temperature is observed directly and the index shows on the scale the exact control temperature. The temperature range is from 400 to 3,000 deg. F.

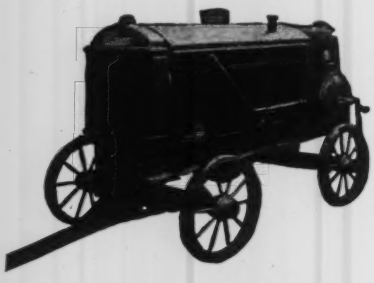
Improvements Developed for Portable Asphalt Repair Plant

The new model E-3 portable asphalt repair plant, manufactured by the Chausse Oil Burner Co., Elkhart Ind., is the result of a development through a period of three years with its model E-1 and E-2. The equipment is mechanically operated, using a rotary sand drier, pug mill mixer, oil burners and measuring devices, all of which are found in stationary plants. In addition, however, this plant has features of self-propulsion on rubber-tired wheels together with storage bins for material. The plant is equipped with Continental Red Seal four cylinder engine and a structural steel frame and body is used throughout.

The capacity is 150 sq.yd. 2 in. compacted mix per 8 hour day. Old asphalt can be cut from the street, loaded into the sand drier, heated to 350 degrees agitated in the mixer, new asphalt added and returned to the street, thus providing a marked economy in patching costs. A tool heater, with oil burner, is located at the rear of the machine for heating rakes, tampers, shovels and smoothing irons. The machine can be towed to the location of the work but arriving there, it will propel itself at speeds of four to five m.p.h.

Compressor Equipped With Super-Charger

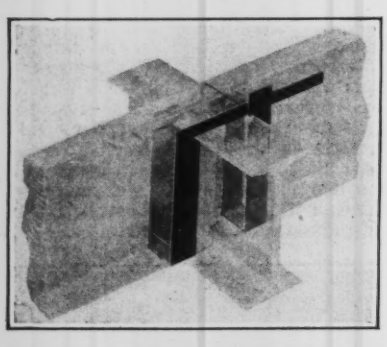
Equipping the Thor portable air compressor, manufactured by the Independent Pneumatic Tool Co., Chicago, with a super-charger, is claimed to have increased the volume of air nearly 50 per cent. The power plant used on



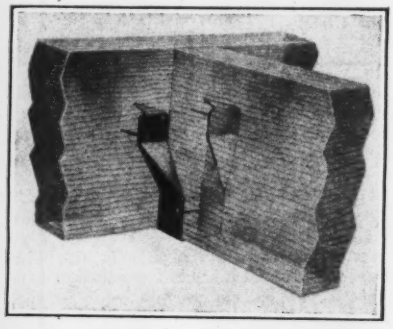
the compressor is a four-cylinder valve-in-head type claimed to be a very simple unit because of the absence of clutches, couplings or gears. Cast steel is used for the frame of the machine to increase its rigidity. The standard mounting is on a heavy-duty steel wheel wagon but other mountings are available on rubber-tired wheels, trailers, trucks or skids.

New Hangers Designed for Non-Sagging Floor Construction

Two new products recently introduced by the Blaw-Knox Co., Pittsburgh, are a hanger for attaching wood joists to steel I-beams and a hanger



for hanging joists on wood framing. These hangers are shown in the accompanying illustrations. The hanger used with the steel I-beams has been developed to eliminate such connections as wood joists toe-nailed to wooden strips bolted to the I-beams or steel shelf angles supporting the wooden joists. The hanger is designed not only to connect the wood joist to the steel I-beam but to make the wood



joist practically continuous across the I-beam. No drilling or punching of I-beams or shelf angles is necessary and joists can be installed in any location with these hangers.

The joist hanger shown for wooden framing has two sharpened tongs at the end which are driven into the side of the header securely supporting the joist in any desired position. The hangers are quickly and easily applied and both types are claimed to insure a rigid, non-sagging floor.

Manufacturers and Trade Associations

Calendar

Annual Meetings

NATIONAL LIME ASSOCIATION, Washington, D. C.; Annual Business Meeting, White Sulphur Springs, W. Va., May 17-18-19.

RAIL STEEL BAR ASSOCIATION, Chicago; Semi-annual meeting, New York City, May 20.

WATERWORKS MANUFACTURERS ASSOCIATION, New York; Annual meeting, Chicago, June 6-10.

NATIONAL HARDWOOD LUMBER ASSOCIATION, Chicago; Annual Convention, Chicago, Sept. 15-16.

AMERICAN PAINT & VARNISH MANUFACTURERS ASSOCIATION, Philadelphia; Annual Convention, Atlantic City, Oct. 24-25.

NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

ASPHALT ASSOCIATION, New York; Annual Convention, Atlanta, Nov. 28-Dec. 2.

New Publications

Contractors' Equipment — HELTZEL STEEL FORM & IRON CO., Warren, Ohio, has issued a new 32-p. catalog describing and illustrating its equipment for both building and highway contractors. The booklet is divided into five parts, devoted respectively to bin equipment, road equipment, street equipment and general equipment under which are listed car chutes, manhole forms, mixing boxes, mortar boards, precast pipe, sewer forms, tool boxes. Lastly, a page of illustrations is shown giving an idea of the steel plate work done in the company's fabricating shop.

Power Shovels and Cranes — HARNISCHFELDER SALES CORP., Milwaukee, Wis., has just made available a bulletin covering its new line of gasoline engine driven shovels. The bulletin, called 61-X, contains 56 pp. and 96 illustrations. The illustrations are both of machine details and of actual construction operations. Information is given on draglines, shovels, cranes, piledrivers, skimmer scoops, trench hoes, trench excavators, and truck cranes.

Handling Bulk Materials—R. H. BEAUMONT CO., 319 Arch St., Philadelphia, has issued Bulletin No. 79 containing 28 pp. and describing its "Skip-Lift" installations which consist of bucket, cable, guides and hoist, used for elevating and conveying such materials as coal, gravel, sand, stone, etc. The installations are automatic, semi-automatic, or manually operated, and the catalog gives line drawings of 10 different types to be used under different operating conditions. The installation is either self-supporting or is built-in to the building when used at an industrial plant.

Structural Steel Welding—WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., in special publication 1767, discusses the arc welding of structural steel. The publication contains 31 pp., the first part of which deals with the arc-welded buildings at the company's plant. Erection methods, tests, and inspection of arc welds and the metallurgy of welding are discussed. A detailed description, including many photographs, is given of the tests conducted at the Carnegie Institute of Technology and a description of the company's single and multiple operator arc welding equipment, the gas engine driven and the portable belted generators and the automatic welding heads are also considered.

Drilling and Boring Machinery—LOOMIS MACHINE CO., Tiffin, Ohio, has made available in its catalog descriptions of all of the blast hole, well drilling, boring and prospecting machinery and tools which it manufactures. Many illustrations are given. Specifications complete the catalog.

Gasoline Shovels—ORTON CRANE & SHOVEL CO., Chicago, has issued bulletin No. 42 illustrating its model "V" ½-yd. gasoline shovel. The operating mechanism of the shovel is shown in detail by illustrations and, in addition to the specifications and general descriptive matter, many illustrations of the shovel on construction jobs are given.

Diesel Engines—FULTON IRON WORKS CO., St. Louis, Mo., has issued a 27 page booklet describing its four cycle air injection Diesel engines in horsepower readings from 300 to 2,000. Besides information on the design and construction of the company's engines, the booklet shows details of the important component parts. The booklet contains general information on four cycle Diesel engines.

Business Side of Construction

Facts and Events That Affect Cost and Volume

This Week's Contracts—With Comparisons

Minimum costs observed are: $15,000 for water-works and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, institutional, religious and other buildings.

Week ended	Public Work	Private Work	Total Contracts
May 19, 1927	$32,923,000	$51,247,000	$84,170,000
May 12, 1927	47,101,000	18,208,000	65,309,000
May 20, 1926	31,192,000	37,975,000	70,167,000
Jan. 1 to date			
1927	416,179,000	682,468,000	1,098,647,000
1926	382,493,000	680,849,000	1,063,342,000

E.N.-R. Index Numbers On May 1, 1927

COST	VOLUME
206.80	257

The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1926, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 48-page pamphlet entitled Engineering News-Record Construction Costs.

Weekly Construction Market

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.87½	$3.00	$3.00	$3.80
Structural rivets, 100 lb.	5.00	3.80	4.75	3.50	3.75	4.65	5.00	5.00	7.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	2.75	2.30@2.50	2.87½	3.87½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	48%	41%	42@53.8%	48%	37.83
Cast-iron pipe, 6 in. and over, ton	48.60	42.00	54.00	46.20	48.50	56.50	56.00	55.00	62.50
Concreting Material									
Cement without bags, bbl.	2.35@2.50	2.35	2.05	2.05	2.22	2.85	2.51	2.65	1.15
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.70	1.65	1.90	1.80	1.25	1.90
Sand, cu.yd.	1.00	1.60	2.00	1.65	1.25	1.00	1.40	1.25	1.35
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59@61	34.00	56.00	40.50	39.75	34.25	27.00	23.00	50.00
Lime, finishing, hydrated, ton	18.20	22.00	19.00	20.00	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl	2.10@3.00	1.50	1.82	1.50	1.70	2.70	1.70	2.80	10.00
Common brick, delivered, 1,000	19@20	12.00	14.10	12.00	13.75	9@10	14.00	14.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.076	.072	.085	.....	.10	.10
Hollow partition tile 4x12x12, per block	.1027	.0895	.112	.076	.072	.085	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	.87¾	+.93¾	1.10	.90	.97½	1.10	.89	.95	1.05
Common Labor									
Common labor, union, hour	.90⅜	.30	.....	.90	.....	.....	.60	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	....	.45@.60	.31¼@.50	.50	.62½	30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel), shapes and rivets delivered to job in less-than-carload lots.

Labor—Cement and concrete laborers' rate, $1.06¼; building laborers, 90⅜c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b. Fir is quoted instead of pine. Reinforcing bars (billet steel) and rivets f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) and rivets at warehouse in carload lots; shapes, less-than-carload lots. Steel pipe under 3-in., 51% off list.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 5, the next on June 2.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) rivets and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) and rivets, f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) carlots; shapes and rivets, less-than-carload lots.

San Francisco quotes on Heath tile, size 5⅓ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes and rivets, less-than-carload lots.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) carlots; shapes and rivets, l.c.l.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.06). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, in carload lots; rivets, l.c.l.

UNIT PRICES For actual prices bid on materials in place at various construction jobs throughout the country see p. 76-78 of this issue, following Construction News.

Building Materials Price Decline In Line With That of Other Commodities

Demand as Indicated By Contracts Let and Quantities Shipped Shows Volume Close to 1926

EACH succeeeding report shows prices in the general wholesale market continuing the downward trend taken in the early autumn of last year.

About two months after wholesale commodities began this slow descent, building materials, as a group, started in the same direction. Both are on the down-grade at the present time.

Brick, which for five years offered the strongest resistance to price declines, has given way with the rest of the basic materials, leaving steel a little better off than the others, so far as holding the quoted price levels is concerned. The foregoing refers to the market in a nation-wide sense, as gaged by regular weekly reports from the principal industrial districts of the country.

The apparent firmness in steel is probably due more to the recent upward movement in prices of black and galvanized sheets than to any change in bars, shapes, plates, etc. The three principal hot-rolled materials sell at $1.90 per 100 lb., Pittsburgh mill, in carload quantities, with $1.80 mentioned on the shapes and plates in connection with exceptional tonnages. Blue-annealed sheet prices are down as are quotations covering almost every description of scrap.

Demand runs to small lots in pig-iron, while railway and automotive steel buying appears slower. Cast-iron pipe requirments hold to fairly high seasonal levels.

Despite statements to the effect that materials prices are slowly receding, demand as measured by contracts let, is close to that of the first twenty weeks of 1926.

Actual quantities of materials required are also in larger volume than at this time last year, according to latest available data.

Hardwood lumber, cement and brick movements are all substantially ahead of last year at this time. Slight recession, however, is evident in the softwood lumber movement, also steel ingot production and bookings of steel orders.

There is at least 4 per cent more cement stored at mills throughout the country than at this time last year.

The following table shows the situation as to production, shipments and demand in the principal materials, as compared with this time last year.

Lumber data are from the National Lumber Manufacturers Association; cement, from the Bureau of Mines; brick, from the Common Brick Manufacturers Association of America; steel ingot output, American Iron and Steel Institute; unfilled steel tonnage, on books of the United States Steel Corporation as of the last day of the month.

These figures are for the nation as a whole, assuming, of course, that the organizations mentioned include in their membership the principal mills, plants or yards in each industry represented.

THE SITUATION AS TO SUPPLY AND DEMAND IN FIVE IMPORTANT MATERIALS

			Per Cent Gain (+) or Loss (—) in
Softwood Lumber			
(First Eighteen Weeks)	1927	1926	1927
Production, ft.	3,359,988,000	4,055,594,000	—17.5
Shipments, ft.	3,499,559,000	4,228,006,000	—19.0
Orders, ft.	3,617,962,000	4,249,719,000	—14.2
Hardwood Lumber			
(First Eighteen Weeks)			
Production, ft.	502,188,000	495,339,000	+ 1.4
Shipments, ft.	528,246,000	476,003,000	+10.9
Orders, ft.	555,976,000	478,990,000	+16.1
Steel Ingots			
(First Four Months)			
Production, tons	16,262,161	16,491,677	— 1.2
Steel Orders			
(On April 30) tons	3,456,132	3,867,976	—10.5
Portland Cement			
(First Four Months)			
Production, bbl.	41,135,000	38,448,000	+ 7.0
Shipments, bbl.	38,132,000	33,998,000	+12.3
Stocks, Apr. 30, bbl.	23,620,000	22,710,000	+ 3.9
Common Brick			
(As of April 1)			
Burned, at yards	427,484,000	339,392,000	+25.9
Unburned, at yards	69,160,000	69,597,000	— 0.5
Moved from yards during month	184,206,000	150,485,000	+22.6
Orders on books	369,857,000	280,612,000	+31.7

Steel Products Required by P.R.R. in 1926 Total $57,000,000

A total expenditure of $164,049,700 by the Pennsylvania Railroad, during the year 1926, for fuel and materials exclusive of new cars and engines, includes the following items:

Material	Value	Per Cent of Total
Steel rails	$9,533,263	5.7
Frogs, switches and rail fastenings	9,713,187	5.9
Wheels, axles and tires	4,647,155	2.8
Locomotive flues and tubes	1,603,678	0.9
Other iron and steel products	32,149,923	19.5
Cross-ties	6,986,168	4.2
Timber and lumber	4,151,003	2.5
Other forest products	2,215,010	1.3
Ballast	1,811,843	1.0
Air brake material	2,844,263	1.7

Colombia Awards Big Culvert Order In U. S.

What is believed to be the largest single order for corrugated culverts ever awarded to any manufacturer of this material in the United States was received by the Canton Culvert & Silo Co., Canton, O., during the last month.

The Government of Colombia, S. A., was the purchaser of the 750 ton shipment, which comprised 2,000 lin.ft. of 72-in.; 2,000 lin.ft., 60-in.; 4,000 lin.ft., 48-in., 8,000 lin.ft., 36-in.; 16,000 lin.ft., 24 in., Acme (nestable) Toncan Iron corrugated culverts to be used in highway construction.

Next Week — Water-works Construction on New Plane of Expenditure Since 1923—Situation Also Measured By Ratio of Proposed Projects to Actual Contracts Let.

Special Tabulation of Unit Prices

Cast-Iron Pipe

The following unit costs (furnishing and laying) on standard sizes, bell and spigot type, are included in low bidders' estimates on various projects, 1922 to 1927:

Location	Date	Tons	Price per Ton
Sewage treatment works Marion, O.	Aug., 1922	110	$80.00
Water supply Tulsa, Okla.	Sept., 1922	24	90.00
Water-works Memphis, Tenn.	Oct., 1922	210	73.23
Sewerage system Dover, N. J.	Oct., 1922	32	90.00
Conduits Brooklyn, N. Y.	Dec., 1922	175	60.00
Conduits Brooklyn, N. Y.	Mar., 1923	140	101.60
Sewers New Castle, Pa.	Mar., 1923	117	82.70
Sewers Pottstown, Pa.	Apr., 1923	5	100.00
Coagulation basin Cleveland, O.	May, 1923	108	80.00
Trunk sewer Dover-Boonton, N. J.	May, 1923	25	125.00
Bridge Haverhill, Mass.	June, 1923	30	143.00
Watermains Cleveland, O.	June, 1923	1,045	83.00
Service mains Cleveland, O.	July, 1923	2,390	83.00
Watermains Cleveland, O.	Aug., 1923	1,890	81.00
Tunnel Cleveland, O.	Nov., 1923	260	82.50
Watermains Cleveland, O.	Nov., 1923	930	78.00
Conduit New York, N. Y.	Jan., 1924	35	90.00
Conduit Brooklyn, N. Y.	Feb., 1924	140	100.00
Watermains Cleveland, O.	May, 1924	995	75.00
Conduit Brooklyn, N. Y.	Jan., 1925	100	100.00
Subway, Sect. 3A, R78 New York, N. Y.	Jan., 1925	175	120.00
Conduit Brooklyn, N. Y.	Feb., 1925	140	100.00
Subway, Sect. 1, R78 New York, N. Y.	Apr., 1925	350	100.00
Impounding reservoir Ashland, Pa.	Apr., 1925	62	100.00
Subway Sect. 1, R5 New York, N. Y.	Sept., 1925	20	150.00
Subway Sect. 4, R102 New York, N. Y.	Oct., 1925	300	125.00
Subway Sect. 7, R78 New York, N. Y.	Nov., 1925	5	125.00
Subway Sect. 3, R102 New York, N. Y.	Dec., 1925	250	130.00
Subway, Sect. 2, R102 New York, N. Y.	Dec., 1925	10	100.00
Viaduct Jersey City, N. J.	Mar., 1926	20	170.00
Subway Sect. 5, R102 New York, N. Y.	Mar., 1926	150	120.00
Subway Sect. 6E1, R8 New York, N. Y.	Aug., 1926	20	100.00
Subway Sect. 1, R102 New York, N. Y.	Sept., 1926	15	100.00
Subway, Sect. 3&4, R1	Dec., 1926	255	100.00
Sewage treatment works New York, N. Y.	Jan., 1927	25	180.00
Sewerage system Hunter, N. Y.	Mar., 1927	155	80.00

Structural Steel

The following unit prices are included in the low bidders' estimates on various subway jobs, 1924 to date:

Location	Date	Tons	Price Per Ton
Philadelphia, Pa.	Oct., 1924	8,700	$150.00
New York, N. Y. S3A R78	Jan., 1925	2,800 1,800	125.00 118.00
Philadelphia, Pa.	Mar., 1925	12,500	130.00
New York, N. Y. S1 R 78	Apr. 1925	2,620	116.00
S6 R 78	July 1925	4,000	120.00
S7 R 78	Nov., 1925	2,450	118.00
S3 R102	Dec., 1925	4,450	122.00
S2 R102	Dec., 1925	2,850	140.00
S8 R 78	Mar., 1926	1,160	125.00
S5 R102	Mar., 1926	5,950	120.00
E E Agreement	July, 1926	83	120.00
Brooklyn, N. Y. S 6-E-1 R 8	Aug., 1926	1,210	123.00
New York, N. Y. S1 R 102	Sept., 1926	4,540	125.00
S 3 and 4 R 101	Dec., 1926	23,150	120.0
S 6 C R 78	Mar., 1927	670	115.00